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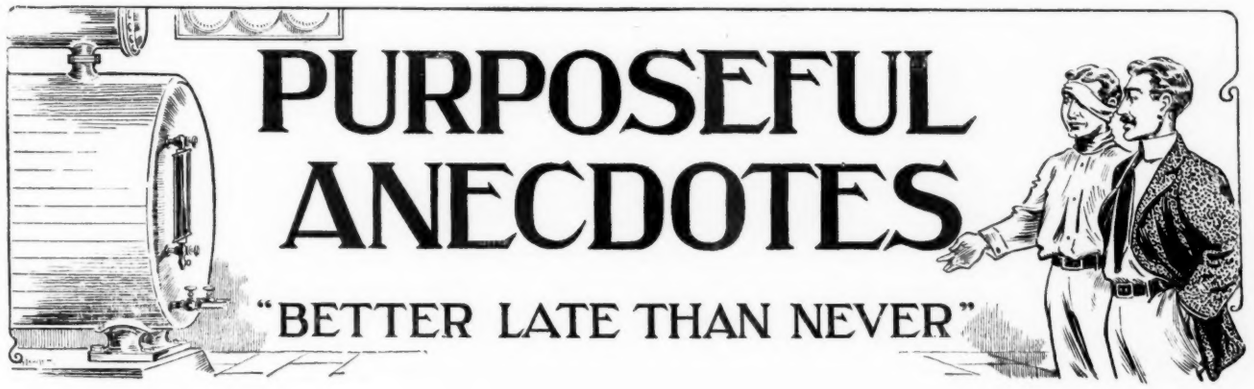


JONES is engineer in the plant of Blank & Co., and it is his job to operate, together with considerable other apparatus, an absorption refrigerating plant.

I found him busy. There was nothing strange about that, but his appearance was a little out of the ordinary. A cloth bandage was around his throat and one eye was hidden by a bandage. Of course, I had to know what the trouble was and made haste to inquire.

"Trouble?" said he. "No such thing as that here now. I am one of the happiest men alive. I know my appearance does not seem in harmony with that statement, but listen:

"One evening while I was on duty, about a week ago, the refrigerating plant sprung an ammonia leak. After a search I found it in the bottom gage-glass nut on the receiver. This nut had been recently packed, so I got a wrench and, after closing the valves, took up on the packing nut, after which I opened the valves again.

"There was 120 lb. pressure on the condenser. I had protected my face while opening the valves and, after a reasonable length of time, turned to the glass again. At the instant I faced the glass there was a loud report, and the next thing I knew I was trying to hold my eyes in their sockets with my hands, while I stumbled as best I could in the direction of the water tap at the other end of the room.

"For awhile I could not tell by the feel whether or not the flying particles from the exploded gage-glass had put out my eyes. I put into them all the water I could, and finally discovered that I would be able to see again. Then I became conscious of a warm, wet feeling under the chin. A piece of glass had struck my throat, cutting quite a gash. There was no pain in this wound, but I was mighty glad when it stopped bleeding.

"The next day I went to an eye specialist and had him look for glass in my eyes. He found none, which was certainly a surprise to me, as the gage-glass broke into innumerable pieces when it exploded, and my face was right in front of it. The only piece I could find was about an inch long and was lying on the floor near where I stood when the explosion occurred Probably that is the piece which tried to find my jugular vein.

"Although my eyes escaped the flying glass, they were badly burned by the ammonia. Fortunately, I have lost no time because of the accident and have thanked my lucky stars many times that things turned out the way they did.

"Since this happened the gage-glasses have all been fitted with guards. That is something like locking the stable door after the horse is stolen, but it may be the means of preventing a similar accident in the future."

After congratulating Jones on his narrow escape from serious injury, I bade him "good night." On the way home I fell to wondering how much discomfort Jones could have been spared if SAFETY FIRST had sooner been one of his mottoes.

By H. G. GIBSON

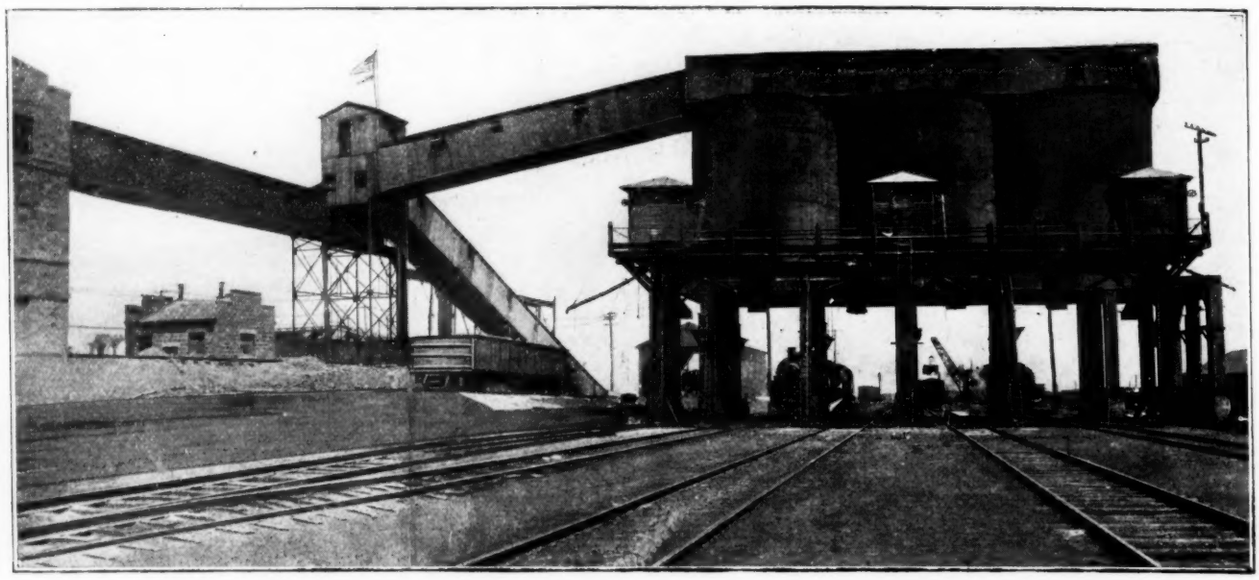


FIG. 1. VIEW OF THE THREE 500-TON CAPACITY CONCRETE COAL BINS, CONVEYOR AND COALING TRACKS

Handling Roundhouse Coal

A modern coal-handling system of belt conveyors for stocking and conveying coal to bins for locomotive and boiler-room use has been installed at the new Croxton roundhouse of the Erie Railroad. The system is capable of handling 100 tons of coal per hour.

THE experiences of the last few years have demonstrated the necessity of storing a supply of coal for emergency and reserve. It has been the custom for large power plants and railroads to stock coal for future use, because of the uncertainty of always obtaining a supply when required, owing to market conditions, labor troubles and transportation delays. As is well known, anthracite can be stored in unlimited quantities without danger of spontaneous combustion, but most bituminous coals will ignite when stacked in large piles.

Certain precautions should be taken in storing soft coal. It is best not to make the pile higher than twelve feet and of such proportions that any interior point will not be more than ten feet from an air-cooled surface. When unloading coal, the lumps will naturally roll to the bottom of the pile. This should be avoided if possible, as air passages are formed between the lumps. It is the belief of many that coal should not be allowed to remain for a period longer than two months without being turned over. Naturally, the cost of storing coal varies with the method of handling, especially at present-day wages for labor. Therefore, labor-saving apparatus is extensively used, as this not only reduces the cost of handling, but is quicker and in many instances can handle coal to points where it would otherwise be impossible or impracticable to store it.

When the Erie Railroad maintained a roundhouse near the old tunnel at what is now known as Croxton, Jersey City, N. J., the method of storing coal common in many places was to build a track to the storage area and as the cars were unloaded and the pile of coal increased in height, the track was elevated with it and

FIG. 2. VIEW OF THE UNLOADING SHED

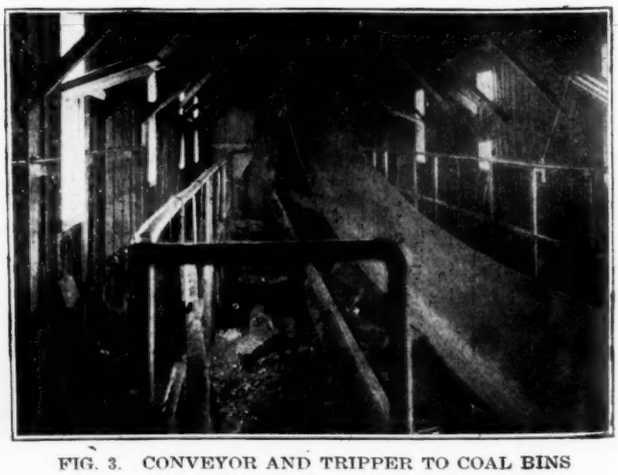
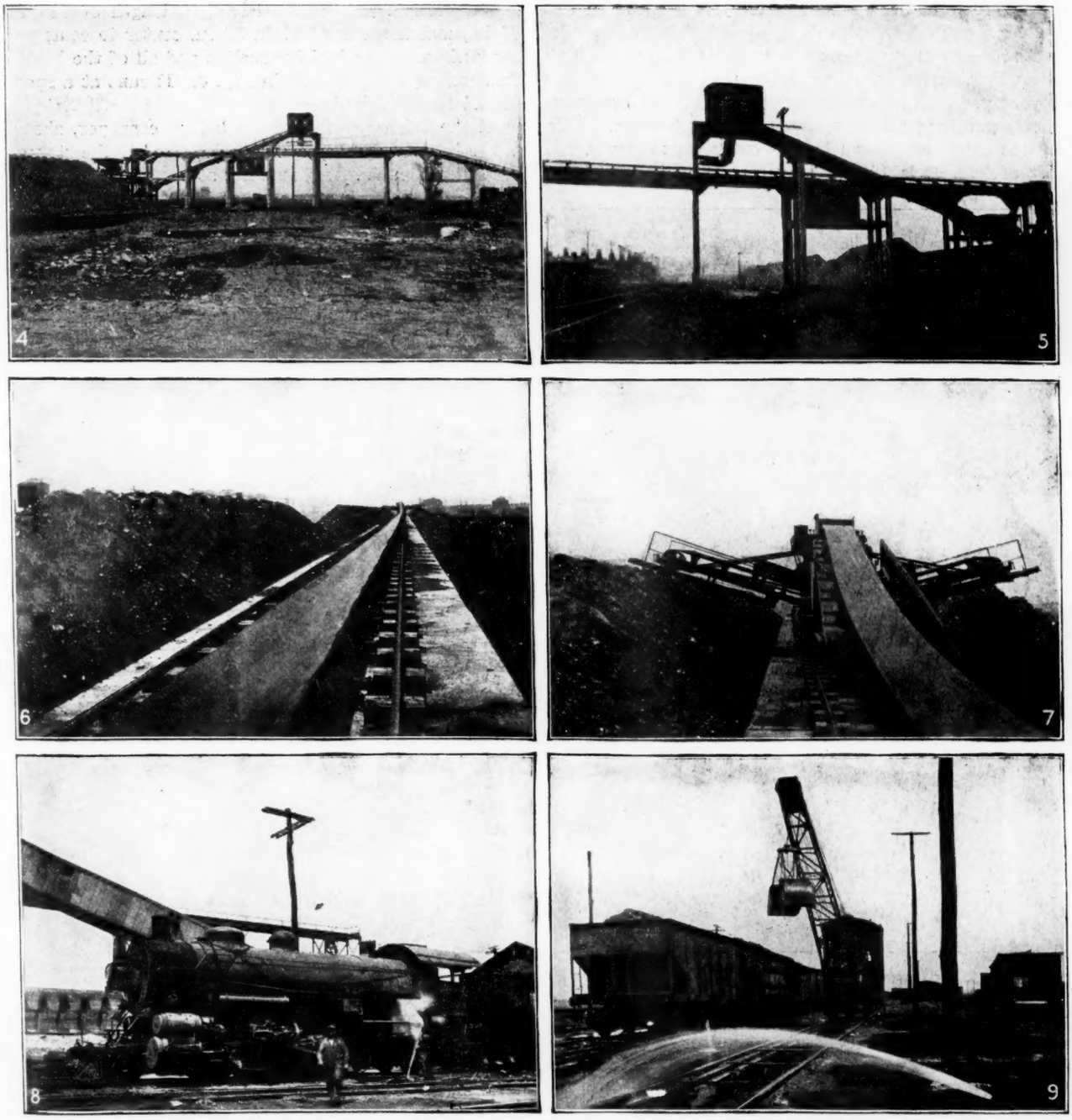


FIG. 3. CONVEYOR AND TRIPPER TO COAL BINS

moved sidewise as necessary for the continued unloading, thus keeping the track on top of the pile. The cost of this method of storing coal was made up of the labor of the shifter crew and the men engaged in unloading the cars. Then there was the labor of reclaiming the stored coal, which was generally done with a locomotive crane and bucket hoist. The car-shifting crew was also included in the reclaiming cost. The cost of handling storage coal varies according to the conditions under which it is unloaded, ranging from about two cents per ton to fifteen or twenty cents, depending on the method employed.

About a year ago a new roundhouse was built at the Croxton yard, and considerable consideration was given not only to its design but also to the handling of coal for the locomotives, delivering it to a storage pile, handling ashes and drying sand.

From the unloading shed the coal is distributed to three destinations—the locomotive coaling bin, the boiler house, and the storage pile. Motor-driven Robins belt conveyors are used for each delivery.



FIGS. 4 TO 9. VIEWS OF THE COAL-CONVEYING BELTS, STORAGE PILE AND ASH-DISPOSAL PITS

Fig. 4—Bridge conveyor over main-line passenger tracks. Fig. 5—Reclaiming belt from the storage to bridge belt. Fig. 6—Storage conveyor. Fig. 7—Tripper of storage conveyor. Fig. 8—Washing down an engine after cleaning ashpan. Fig. 9—Loading ash cars from ashpits.

Coal is delivered at the yard in hopper-bottomed cars and is then shifted into the unloading shed where two tracks pass over a discharging pit, permitting two cars of coal to be unloaded at once. Fig. 2 shows a loaded car ready for dumping and a locomotive about to remove

an empty. A 50-ton car of coal can be unloaded into the pocket and delivered to the conveyor in 29 minutes. The discharging pit is made with sloping sides and ends so that the coal will feed by gravity to the bottom outlet upon a short 30-in. feeder belt that discharges either upon an inclined belt running at right angles to it or upon the bridge conveyor that runs in a direct line away from the feeder belt, which has a speed of 125 ft. per minute.

As the coal is for locomotive use, it is not run through a crusher, but a man is stationed at the incline conveyor feeding the locomotive-coaling bin to break up the larger lumps as they are carried past him. This incline conveyor, shown by the covered runway at the left of Fig. 1, is 195 ft. long center to center of the pulleys, 30 in. wide, and runs at a speed of 112 ft. per min. At the top of the incline conveyor the coal is discharged to a second belt, Fig. 3, that runs at a right angle to it and at a slight incline for a short distance and then horizontally. This belt is equipped with a traveling unloader for discharging into either one of three 500-ton reinforced-concrete coal bins, Fig. 1. Each bin is 27 ft. in diameter, 32 ft. high, and has walls 7 in. thick. Below there are six tracks so that two passenger, two freight and two shifting engines can coal at the same time without interfering with one another.

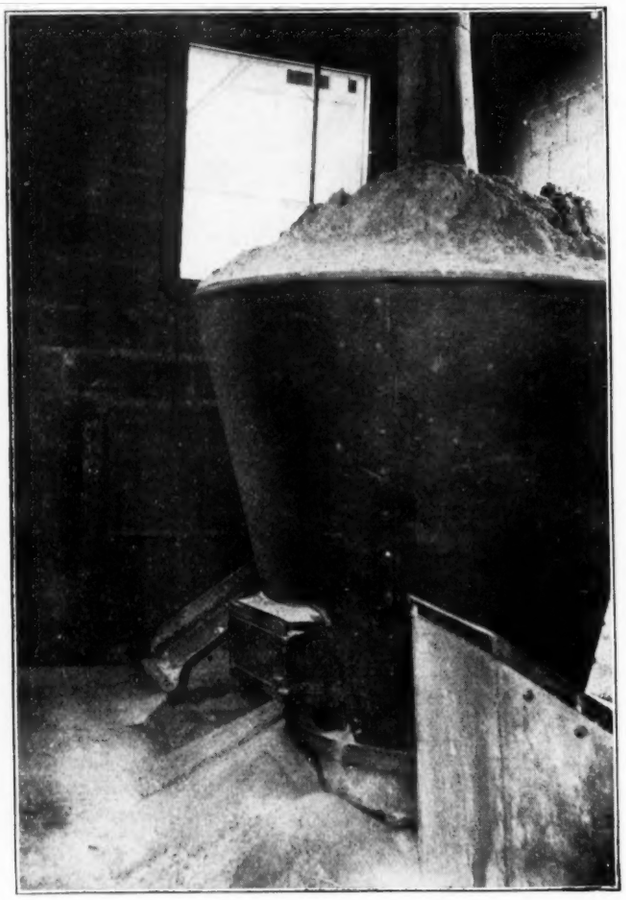


FIG. 10. DRYING SAND FOR LOCOMOTIVE USE

When coal is to be delivered to the storage area, which has a capacity of from 15,000 to 25,000 tons according to the manner of storing (that is, if the coal is repiled by using a locomotive crane and bucket the latter tonnage can be stored) the discharging hopper and the feeder conveyor are made to feed to a bridge belt conveyor that extends from the dumping shed to the storage conveyor. This bridge conveyor spans the main passenger tracks and has a total length of 259 ft. 8⅝ in. center to center of the pulleys. It consists of an incline from the feeder belt and a horizontal section, the former having a length of 123 ft. 4¾ in., and the latter 136 ft. 3⅞ in. center to center of the pulleys. A part of the incline and all of the bridge cross-conveyor are shown in Fig. 4. It runs at a speed of 114 ft. per minute.

At the discharge end of the bridge conveyor, shown at the left of Fig. 4, the coal is delivered to the storage belt, 742 ft. 4½ in. long, running at speed of 233 ft. per min. This belt runs on a concrete trestle between the tracks on which the unloader runs, also the reclaiming hopper, which is shown at the left of Fig. 4. The unloader is equipped with two short belts that run at right angles to the main storage belt, and the coal is discharged at both sides of the trestle, as shown in Fig. 6. A near view of the unloader is shown in Fig. 7.

Each unloading belt is 13 ft. long. The unloader is propelled from one position to another by means of a friction drive, power being obtained from the main conveyor belt. A reversing gear permits moving the unloader in either direction.

On each side of the storage trestle is a wide-gage track on which a locomotive crane operates. When storing coal it is piled on these tracks, and when the storage coal is to be reclaimed it is picked up by the crane bucket and dumped into the movable hopper from which it is discharged to the main conveyor belt, which can be run in either direction. An even distribution of the coal from the hopper to the belt is obtained by means of a vibrating or shaking bottom which pushes the coal out upon the belt with a gradual feed and not in a pile, as would be the case were the opening in the bottom of the hopper direct to the belt.

When reclaiming coal, the storage conveyor runs toward the bridge conveyor and discharges upon an incline belt, Fig. 5, 85 ft. 7 in. long and running at a speed of 287 ft. per min. This conveyor discharges into a hopper at the top of the bridge and is fed automatically upon the bridge conveyor, which is also reversible and thus carries the coal to the incline belt that runs to the locomotive coaling bin.

There is yet another conveyor belt, called a shuttle, which runs at a speed of 300 ft. per min. This is used for handling anthracite for the boiler house and sand for the locomotives. When handling coal for the boiler house it operates the same as when handling bituminous coal. The coal is delivered to the unloading house and is taken by the feeder conveyor to the incline conveyor, Fig. 1, but instead of going to the concrete bins it is discharged in the opposite direction to the shuttle conveyor, shown by the housing at the extreme left of Fig. 1, and is then discharged into the coal bunker in the boiler house, from which it is fed to the boiler stokers.

Sand is handled in the same way and by the same belt conveyors, with the exception that the shuttle belt is reversed and the sand is discharged into spouts that carry it to a sand bin adjoining a drying house. This sand is dried in the type of drier shown in Fig. 10. It

is loaded into a small industrial car and brought to the drying room, is shoveled into the drier at the top wet and comes out at the bottom dry. It is then shoveled upon screens shown at either side of the drier, and runs into a closed pressure tank from which it is blown by compressed air into the square sand tank shown in front of the coal tank, Fig. 1. From these tanks the sand is taken by the locomotives at the time of coaling. It requires about one hour to dry the sand.

The manner of handling ashes, although not connected with the conveyor system, is of interest. The locomotives are run on a track having concrete pits beneath them and at the side. Their position is shown in Fig. 1, where several locomotives are seen standing on the tracks over the ashpits. One is shown in Fig. 8 just after coming off the ashpit. To clean off the dust that has settled on the engines a stream of water from a hose is used. This makes a rather thorough and quick method of cleaning an engine.

From the ashpit the ashes are removed by a locomotive crane into coal cars, Fig. 9, and are hauled away for filling-in purposes around the adjoining freight yard. As the pits are partly filled with water, the nuisance of smoking coal is done away with.

The new roundhouse contains 36 stalls where the engines are repaired, washed out, etc. An average of 64 engines are coaled each twenty-four hours.

Power Required To Feed a Boiler

A simple way to arrive at the energy, or power, required to feed a boiler with water is first to ascertain the height, in feet, of a column of water or standpipe that will balance the steam pressure in the boiler. This is done by multiplying the steam pressure by 2.3. This multiplier is used because for every 2.3 ft. in height a column of water will exert one pound pressure per square inch at its base. Therefore if the pressure in the boiler is, say, 100 lb., it will support a column of water $2.3 \times 100 = 230$ ft. high. Then, a pound (weight) of water elevated to this height in the column pipe connected to the boiler would cause a like amount to flow into the boiler. Therefore the pounds (weight) of water fed into the boiler multiplied by the height in feet it would have to be elevated (to the top of the column pipe) to produce head enough to cause it to flow into the boiler gives the "foot-pounds" of energy per pound of water fed. To get the horsepower expended, of course the time element, or the rate of feed, enters in. The foot-pounds of energy expended per pound of water fed multiplied by the number of pounds fed per minute and divided by 33,000 gives the required horsepower.

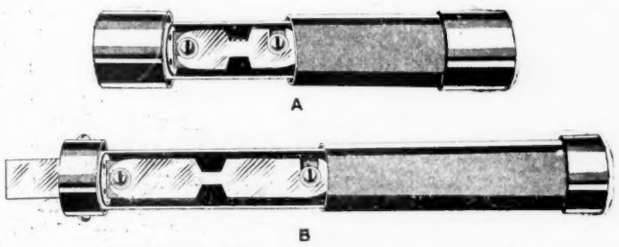
Suppose the boiler-feed pipe has a tee fitting in it just as it enters the boiler, with one opening "looking up," into which the column pipe is connected; then the water from the pump would go directly into the boiler after the required "head" was reached in the column pipe. A correct pressure gage connected in, might be graduated to show either the height in feet of the column of water or the pounds pressure or both. The column pipe can therefore be dispensed with and the gage reading used instead, and if the gage reads pounds pressure, its reading must be multiplied by 2.3 as explained, but if it reads in feet head, its reading is used for the "feet" and the "pounds" is the weight of water fed (giving "foot-pounds").

It becomes an interesting diversion to calculate the power represented by the feed water entering a boiler serving, say, a 100-hp. engine. If the engine takes 30 lb. of steam at 100 lb. gage pressure per horsepower-hour, the energy expended in feeding the boiler would be 100 (hp.) $\times$ 30 (lb.) $\times$ 230 (ft.) $=$ 690,000 ft.-lb. per hour, or 11,500 ft.-lb. per minute. This is only about one-third horsepower for the actual work represented by the water entering the boiler, which is of course a great deal less than the total power applied to the pump in overcoming friction and other losses.

Perfect Ferrule and Knife-Blade Fuses

There was a time when, if a fuse blew, the attendants would attempt to put in a new one while the line was alive, often resulting in a more or less serious burn. When the cartridge type of fuse is used, there is but slight danger of being burned by blowing. The ideal fuse is one that can be refilled quickly and easily, and it would seem that the device made by the Perfect Fuse Co., Inc., 737 Main St., Buffalo, N. Y., not only meets these requirements, but it is a safety fuse as well.

A glance at the accompanying illustration shows the construction of the ferrule and knife-blade types, *A* and *B* respectively. The fuse, as shown, is renewable.



FERRULE AND KNIFE-BLADE FUSES

One end of the fuse link is slotted at the end, and the other is slotted at the side, thus making it convenient for inserting in position, it only being necessary to loosen the two screws, which, when tightened, hold the fuse in place. In a nutshell, to refill the fuse unscrew the cap, pull it apart, loosen the screws, insert the new fuse link, tighten the screws, shut, and in the case of the ferrule type screw on the cap.

It will be seen that the fuse cannot be inserted in the clips unless it is fully closed, thereby making it a safe one to handle. It is made for 250 and 600 volts, ranging from 30 to 600-ampere capacity.

Henry Ford will invest millions in developing water power. A $2,000,000 tractor plant in Hamilton, Ohio, to be operated by water power, will be the first link in the chain. According to Mr. Ford it is intended to develop the water power of small streams for use in the communities where the power is developed, and not transmit power long distances. At Hamilton there will be developed enough power out of the Little Miami River to operate a plant which will turn out 300 tractors daily. Mr. Ford will have several tractor plants when his plan is complete, and he believes that by establishing this method of manufacturing, it will be unnecessary for working men to come to the larger cities.

Some Features of Low-Compression Oil Engines—IV

By L. H. MORRISON

Oil engines of the low-compression type use the throttling type of governor, which regulates the speed by controlling the quantity of oil injected during each cycle. This installment deals with various forms of throttling governors.

THE hit-and-miss method of governing has been tried out on the oil engine, but it has never proved successful, because the cylinder cools too much during the idle strokes, causing poor combustion. While a few builders make use of flyball governors similar to those used on throttling steam engines, the majority use shaft governors of either the inertia or the centrifugal type. The adoption of this plan allows the eccentric to act directly on the injection-pump push-rod and is by far the best in practice.

Governor With Sliding Eccentric

The form of governor shown in Fig. 1 is used extensively, often with certain slight modifications. It consists of two weighted arms pivoted at A to a disk B that is keyed to the crankshaft. The extensions of these arms are pivoted at the points C to the eccentric plate, which is held in guides that are a part of the keyed disk B. As the engine comes up to speed, the arms tend to move outward, this movement being resisted by the tension springs. If the load on the engine is decreased, the engine tends to speed up, and the weights overcome the spring tension and move outward, due to the increased centrifugal effect. This movement causes the eccentric plate to move in the guides, decreases the throw of the eccentric and consequently shortens the stroke of the fuel pump, bringing the engine back to normal speed.

In operation this governor is practically trouble-proof. A point to be remembered is the necessity of keeping the pivots and the guides well oiled. If this is neglected, the eccentric will bind and the engine will tend to race. It is also a good plan to keep a set of spare springs on hand, as the governor springs break frequently.

While it is possible to move the disk on the shaft, it is best not to attempt to alter the setting. The builders always set the eccentric at the point where the oil injection should begin, and the operator can seldom improve the setting. Few builders mark the disk; so, if an attempt is made to change the eccentric position, it is well to mark the original setting before any alteration is made.

The governor shown in Fig. 1 belongs to that class by which the point of the beginning of oil injection, as well as the length of the pump stroke, is altered as the load changes; in other words, both the angular advance and the eccentricity change.

In operation on low loads, the fuel is injected rather late, the crank being about 15 deg. ahead of the rear dead-center. This results in poor combustion, since the oil charge has insufficient time to vaporize and burn. On full load the point of injection advances to practically 45 deg. ahead of dead-center. With heavy fuel oil or "tops" this is not objectionable; in fact, it is an advantage, since there is more time for the heavy charge of oil to burn. But with light oils, such as distillates or a crude containing a considerable percentage of light hydrocarbons, early injection causes preignition. Such preignition often becomes so heavy that it is impossible to stop it by using water injection; for if enough water is used to prevent preignition, the cylinder will be flooded.

The action of this governor may be understood from Figs. 2 and 3. In Fig. 2 the full lines show the eccentric position at low load. The crankshaft center is at O and the center of the eccentric at A. The crank is at an angle a from the center line $X\ Y$. In this position fuel injection is just commencing, as indicated by the contact of the eccentric with the push-rod B of the fuel pump. Under full load the eccentric is moved to the position shown in Fig. 3, the eccentric center being then at A' and contact with the push-rod being made at B'. These same positions are shown dotted in Fig. 2.

In the first position of the eccentric the injection of oil begins when the crank is a degrees from dead-center, and the total movement of the plunger is C. In the new position of the eccentric, the crank is $a + b$ degrees from dead-center when the injection begins, while the total plunger movement is C'. It is apparent that the eccentricity or throw of the eccentric is greater than C, but the difference represents the movement of the eccentric before it strikes the push-rod or the pump plunger and might well be called the "lap" of the pump.

The Rites Type of Governor

Fig. 4 is a sketch of a Rites governor such as is used on one or two makes of oil engines. This type at first glance appears to be the simplest and most reliable of all; however, there are certain features to be borne in mind. Since the governor arm is supported at one point and all the weight is concentrated on a line falling outside of this point the governor is out of balance. All the thrust of the weights is against one side of the pivot or fulcrum pin, and the natural result is wear of this pin on that one side, causing the engine to race or hunt. To offset this defect, it is advisable to give the pin a quarter-turn every 30 days. This will distribute the wear over the entire circumference.

The weights are held in equilibrium by a tension spring, and the speed of the engine is increased by tightening the spring. The engine will regulate more closely if the end of the spring held in the slot in the weight arm is moved outward. Moving it inward decreases the closeness of regulation and makes the governor sluggish in action; but this is the proper way to have the engine govern if it is pulling an industrial load, such as that of a mill.

To dampen the action of the governor, which is in-

herently very sensitive, some kind of drag is used. In Fig. 4 the drag is introduced by using a small plunger *A*, placed in a recess in one of the weights. The outer end of the plunger bears on the inner face of the flywheel rim, against which it is forced by the action of a coil spring *B*. It is necessary to give this plunger considerable clearance, to allow it to move freely, and the side pressure exerted by the governor quite often wears the plunger out of true, causing it to stick in the recess. This, of course, allows the engine to hunt. If the wear is considerable, the proper thing to do is to drill the recess to a larger diameter and turn up a new plunger to fit.

The Rites governor also advances the point of injection and increases the eccentricity as the load increases, as may be seen from Figs. 5 and 6. The full lines in Fig. 5 show the positions of crank, eccentric and weight arm at low load. The eccentricity is *OA* and the crank is *a* degrees from dead-center when the eccentric begins to move the push-rod *B*. The weight arm and eccentric swing on the pivot *C*. The positions under full load are shown in Fig. 6, as well as by the dotted lines in Fig. 5. In changing from one to the other, the eccentric center moves from *A* to *A'* and the eccentricity increases from *OA* to *OA'*. The point of fuel injection is made earlier, because the crank is $a + b$ degrees from dead-center when the eccentric begins to act on the push-rod *B'*.

As mentioned before, early injection is advantageous when using heavy oil, as it allows more time for the fuel to vaporize; consequently, a given size of engine will carry a greater load than it would if the governor did not advance the injection. The Rites governor also has the disadvantage of a tendency to preignition at heavy loads. Further, it should be kept in mind that the position of the pivot of the weight arm, relative to the position of the crank and the center of the eccentric, determines the actual action of the governor. The relative positions of the parts shown in Figs. 5 and 6 closely approximate those on the governors in use.

Fig. 7 shows diagrammatically a method of using the flyball governor on an oil engine. The governor sleeve *A* is connected by a system of links to a cam *B* that bears against a roller or block *C* on the pump plunger *D*. Any movement of the cam will allow the pump to take a longer or shorter suction stroke, as the case may be, and thus the amount of fuel injected is regulated. Such a device is simple and of a type very familiar to the average engineer.

In operating an engine with this method of governing, special pains must be taken with the fuel suction lines. The suction valve in the pump must be maintained absolutely tight and leak-proof. On low loads the stroke of the pump is very slight, so the least leak will prevent the pump from obtaining the required charge. Of course, the governor in such an event will move the stop block to a new position such as will give enough fuel; but this repeated movement will naturally cause the engine to hunt. In an electric-lighting plant this is hardly permissible, as the flicker of the lights will be very noticeable.

A governor of a design that will maintain a constant fuel-injection point regardless of the load carried is without question the most advantageous. Such a governor will relieve the engine of preignition shocks, when these are due to too early injection and not to

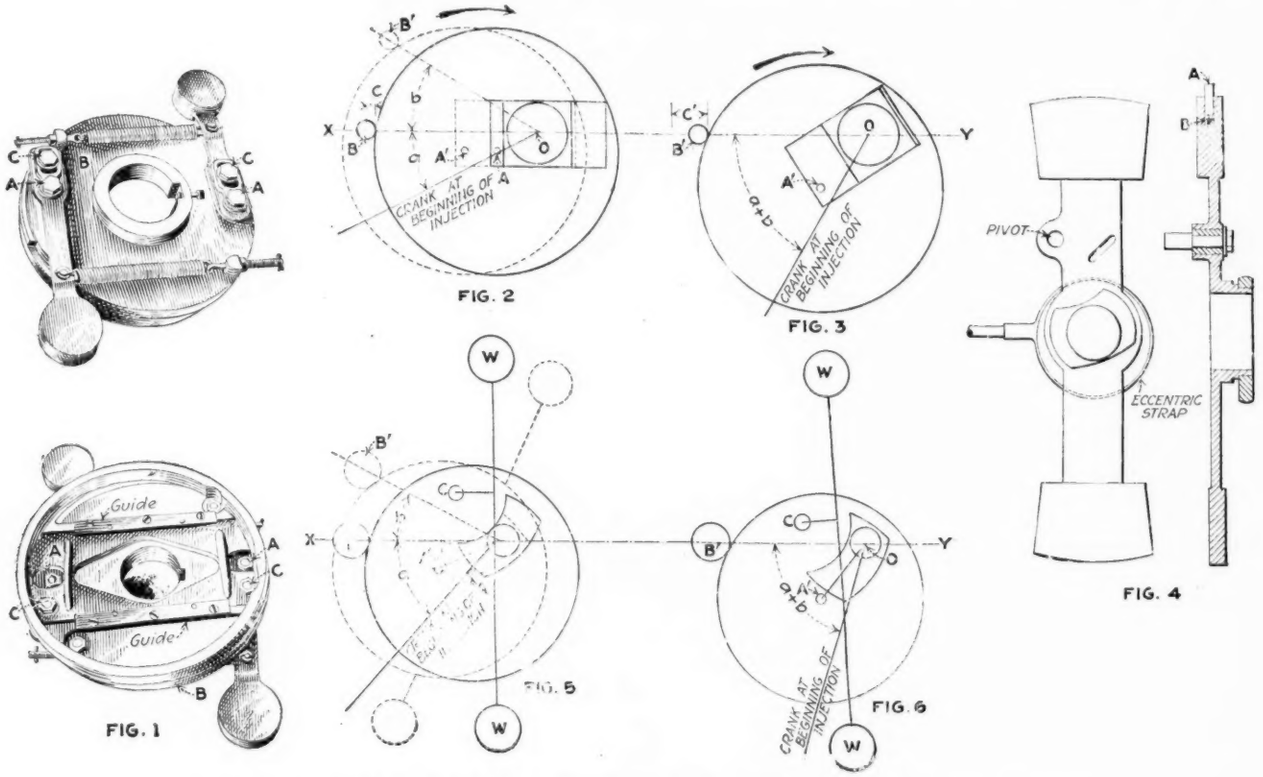


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6

FIGS. 1 TO 6. FORMS OF SHAFT GOVERNORS FOR LOW-COMPRESSION OIL ENGINES

Fig. 1—Governor with sliding eccentric. Figs. 2 and 3—Diagrams showing action of governor in Fig. 1. Fig. 4—Rites type of governor. Figs. 5 and 6—Diagrams showing action of governor in Fig. 4.

poor gas stratification. In an engine in which the oil is vaporized directly in the cylinder, preignition may occur practically regardless of the injection point. The vaporized fuel and the air are fairly well mixed as soon as the oil is sprayed into the cylinder. If the temperature existing in the cylinder, due to the heat absorbed from the previous charge, is high enough, the charge will

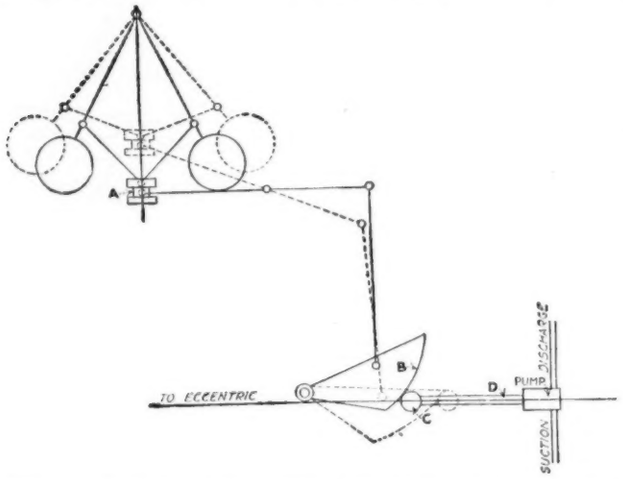


FIG. 7. FLYBALL GOVERNOR APPLIED TO OIL ENGINE

burn considerably before the crank reaches dead-center. On the other hand, if the fuel is introduced at a point but little in advance of dead-center, there can be no preignition.

With governors that vary the angle of advance with the load, there is no danger of preignition at low loads. The contrary is true of the governor with a fixed injection point, when the fuel is vaporized in the cylinder. The statement that the governor with fixed injection point is the better in operation applies only where a combustion chamber is used as the vaporizer. As mentioned before, it obviates the danger of preignition shocks at heavy loads, which is of considerable moment, since the chief item of engine maintenance lies in renewing broken cylinder heads and sprung crankshafts, usually caused by preignition.

It is well, however, to enumerate disadvantages as well as advantages. One source of criticism is the thermal loss occasioned in this type of engine at low load factors. Using the type of governor just referred to, the injection point must be placed early enough in the cycle to enable all the fuel required at full load to be injected before dead-center is reached. It follows that even at low loads the fuel must be introduced rather early. The oil on vaporizing increases the existing pressure in the cylinder, since the gas is absorbing heat from the hot vaporizer as the charge is being compressed. The piston, on the compression stroke, must work against this additional pressure, which pressure gives back practically no additional power to the engine on the working stroke. The loss is especially noticeable in engines using water injection, since the water charge is introduced to offset the increased pressure and temperature.

Another disadvantage lies in the inability of the engine to carry as great an overload as is possible with the engine having a variable injection point. This is due to the fact that the builders so fix the injection point as to allow the full-load fuel charge to be injected and vaporized before dead-center. The beginning of injection is of course made as late as is possible. The result is that the engine is unable to obtain enough of a fuel charge before dead-center is reached to enable it to carry much of an overload. If such an engine does display an ability to handle a large overload, it naturally follows that the injection point is too early for economical operation at partial loads.

The governor shown in Fig. 8 has two arms *A* that carry weights *B* at their outer ends and that are pivoted at *C*. As the speed increases, the weights swing the arms outward against the tension of the springs and the eccentricity of the eccentric is thereby altered. Toothed disks *D* on the arms at the pivot points mesh with a toothed sleeve *E* fixed to the eccentric. When the eccentricity is increased by the movement of the arms, the toothed disks move the eccentric slightly in a counter-clockwise direction, and so compensate for the small increase of angular advance caused by increasing the throw of the eccentric. The point of fuel injection is thus kept practically unchanged at all loads. The teeth on the disks and the sleeve wear somewhat with long usage, but the backlash has little effect. This governor does not require much attention beyond regular oiling of the pivots and the eccentric strap.

The general plan of governor used on single and twin horizontal engines is shown in Fig. 9. The fuel pump

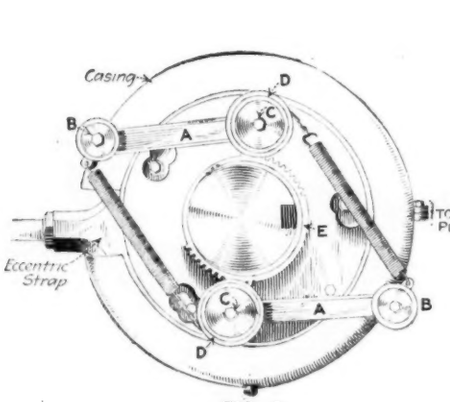


FIG. 8

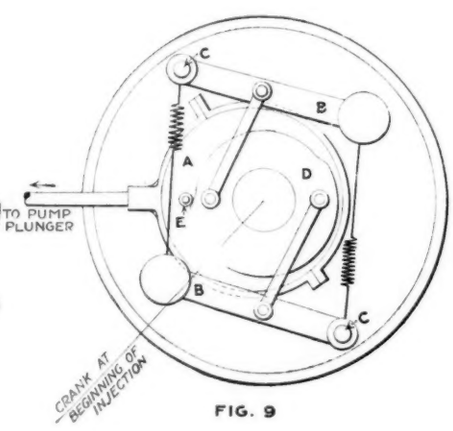


FIG. 9

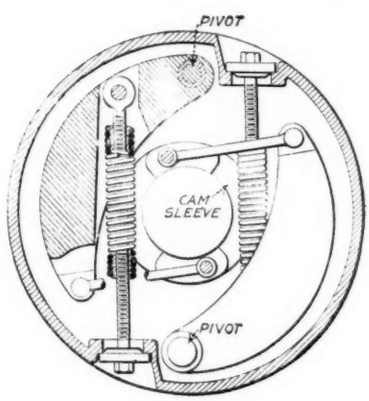


FIG. 10

FIGS. 8 TO 10. FORMS OF GOVERNORS WITH TWO WEIGHT ARMS

is driven by the eccentric *A*, which is fixed on the shaft and set so that the pump begins to inject the fuel at approximately 35 deg. ahead of dead-center. The two weight arms *B* are pivoted at *C* and are connected to a cam *D* that is free to turn either forward or backward on the shaft. The cam opens the suction valve of the pump through the agency of the roller *E* and connections not shown. When operating at a given load, the nose of the cam strikes the roller and opens the suction valve of the pump, thereby stopping the injection of fuel into the cylinder. If the load decreases, the resultant slight increase in speed throws the weights out toward the wheel rim, and the movement is transmitted to the cam by the links shown. The cam will then move to a new position, causing the suction valve to open earlier and decreasing the amount of oil injected.

The particular parts demanding attention are the cam nose and the suction-valve plunger. The hammer blow occasioned by the sudden striking of the valve plunger, opening against a heavy pressure, tends to batter the cam nose, causing it to come into action later. The same cause often damages the end of the valve plunger and some sort of fiber cushion should be used at this point. This is probably as good an all-around governor as can be found. The regulation is good providing the suction valve does not leak. A monthly grinding of this valve ought to keep it in first-class condition, even though the fuel oil used is dirty and full of grit.

Typical Centrifugal Governor Employed on Multicylinder Oil Engines

The governor shown in Fig. 10, which is used on a line of multicylinder engines, is much like that shown in Fig. 9, but as actually used it is opposite to the way it is shown in the illustration; that is, the cam controlled by the weight arms moves counter-clockwise while the engine runs clockwise. The cam is milled on a sleeve which is slipped over the end of the shaft, the governor links being fastened to the end of this sleeve. A fixed cam on the engine shaft begins the injection of oil about 30 deg. before dead-center, and if the governor cam does not open the suction valve before the injection plunger completes its stroke, the oil is all injected when the piston is on center. If the load is low, the governor arms move the movable cam so that the suction valve is opened sufficiently before dead-center to prevent the injection of any excess of oil. The cam is so designed as to allow the suction valve to remain open for a large percentage of the cycle.

There are a great many parts to this governing arrangement, and the numerous pins will usually require renewal after the engine has been in service for some time. The one place to look for trouble in case the governor refuses to deliver oil is in the injection cam. The cam is split and is clamped to the shaft by one cap-screw. If this screw loosens, the cam will move to a position in which the pump plunger will either remain inoperative or will deliver oil during a part of the cycle when the oil will not burn.

The hammer blow due to the sudden movement of the pump plunger causes the plunger to chatter against the cam face, leaving a series of ridges. To eliminate this effect, the cam may be made of hardened steel or have an inlay of steel at the high point or nose. Even though of hardened steel, the nose may wear slightly and make the timing wrong. The same remark applies to the governor cam. Periodically the cams should be checked up, and if the injection begins too late or too early, the correction should be made at once. The pump cam can be moved so that the timing can be corrected, and the engineer should not hesitate to disregard the shop timing marks. Many engines of all types are being operated uneconomically because the engineer is afraid to make any adjustments to take up the wear on cams and like parts.

Use of Peat as Fuel

The Canadian Department of Mines has issued a number of bulletins dealing with the utilization of peat for power production. Bulletins Nos. 1, 9 and 11 are entitled "Investigation of the Peat Bogs and Peat Industry of Canada" and cover the years 1908-9, 1911-12 and 1913-14, respectively. They are comprehensive reports of the detailed examination of peat bogs in the provinces of Ontario, Prince Edward Island, Quebec and Nova Scotia. They show surveys of the extent and depth of the various bogs, together with an estimate of the tonnage of peat available from each and analyses of the peat fuel.

The bulletin entitled "Peat, Lignite and Coal" describes and illustrates the machinery and methods used to excavate, pulp, dry and transport peat. It treats also of the utilization of peat, lignite and coal in producers, with special emphasis on the recovery of tar, pitch and ammonium sulphate.

The report on the "Utilization of Peat Fuel for the Production of Power" is a record of experiments conducted at the fuel-testing station in Ottawa during 1910 and 1911. It is devoted exclusively to a description of the apparatus and methods used in the production of producer gas from peat, with the recovery of such byproducts as sulphate of ammonia and tar. The data obtained from a series of exhaustive tests are presented in graphic and tabular form.

The Commission of Conservation has reprinted from its ninth annual report a paper on "Peat as a Source of Fuel." This paper summarizes the peat resources of Canada and describes the processes by which commercial peat fuel is manufactured. Peat is a clean fuel to handle, has a low ash content, produces no soot, forms no clinker, and is very easy to ignite when starting a fire.

Bulletin No. 17, on "The Value of Peat Fuel for the Generation of Steam," is of most interest to the steam engineer, because it records the results of tests of peat fuel when burned under a Babcock & Wilcox water-tube boiler and a portable locomotive-type boiler. The moisture content of the peat fuel was between 16 and 20 per cent. and the heating value ranged from 7600 to 8100 B.t.u. per lb., as fired. With a boiler pressure of about 100 lb. and a feed-water temperature ranging from 54 to 124 deg. F. the equivalent evaporation from and at 212 deg. F. ranged from 3 to 4 lb. per pound of fuel as fired. The boiler efficiency averaged close to 50 per cent., with a flue-gas temperature of from 700 to 750 deg. F.

Copies of the foregoing publications may be obtained by addressing the Government Printing Bureau, Ottawa, Canada.

Problems Involved in Fuel Changes

By A. BEMENT

Ash, and not coal, is the trouble maker. Operatives do not change the method of firing with the coal. Some concrete instances and the remedies.

CHANGES in coal are always accompanied by more or less confusion and difficulty before the plant operatives become familiar with the situation. Even slight changes, such as difference in size only, cause trouble, but the difficulties of the past are quite simple compared with those of today, under war conditions. Coal differs in four fundamental respects: In its volatile matter, in the size of the pieces, in its physical characteristic of hardness, and in its ash content. The volatile content has been the one generally considered as the most important feature determining quality, and it is, so far as smoke production and heating power are concerned; but the amount and more particularly the character of the ash is of greatest significance, because fusibility and clinkering are governed by its composition, and clinker trouble is preeminently the leading difficulty encountered.

The coal of the Appalachians as compared with the coal from other fields contains a more refractory ash, which does not clinker readily; in fact, in many fires some of it makes no clinkers at all. On account of this feature, as well as low volatile and consequent freedom from smoke, this coal has acquired markets far distant from the point of production, in territories properly belonging to other fields. As an example, a large tonnage of semibituminous coal has been shipped from West Virginia several hundred miles to Chicago for use in that city, although local coal is produced only 60 miles away.

Eastern Firing Practice Carried West

Coal originally in this country meant anthracite. No other was considered worth using. Being low in volatile matter and carrying practically nonfusible ash, it could be burned in the simplest form of furnace. In this way the most primitive furnace practice became established in the Eastern States, and this practice was perpetuated with semibituminous coal as anthracite went out of use. As the country developed from east to west, Eastern furnace practice was extended and followed as a matter of course, because boilers and furnaces were made in the East and shipped to the West, and it was felt necessary that a suitable coal follow the furnace. This is illustrated by the fact that in the West there are thousands of plain firebox boilers in low-pressure heating plants which can use nothing less than semibituminous coal with any degree of satisfaction. Many underfeed-stoker plants in the West have depended on semibituminous coal shipped from a long distance.

In the face of this situation the Government, as a war measure, does the logical thing from an economic transportation standpoint. It insists that the coal of the natural tributary field be used. Unfortunately, however, this measure, which is so desirable as a wartime transportation matter, imposes special hardship on many consumers of coal in factories, power plants, etc. The resulting smoke production is a nuisance that can be borne without complaint for the sake of winning the war. Likewise the lessened heat efficiency due to the greater volatile content and the difference in size are things that may be endured for the same reason, provided the amount of steam needed can be made. It is the failure to get capacity that is troubling most people who have been compelled to change coal, and this failure is due to inability to deal with the ash, which is both greater in amount and more fusible than with Eastern coal.

The remark is often made that a certain coal is bad because it runs on the grate, or that it melts. Now coal never melts, neither does it run on the grate; but ash does. So, when such troubles occur, they are produced by the ash that is associated with the coal as one ingredient of the fuel mixture, and not by the coal itself.

Classification of Ash in Coal

Ash may be classified in four groups: First, that present in the original vegetation. This is a uniformly small and unimportant quantity. Second, dirt washed in with the deposited vegetable matter at the time the seam was formed. This is a variable quantity, ranging from zero up to large amounts. This group of the ash, like the first, is entirely concealed in the clean coal, its presence not being revealed until the coal is burned, when it appears as a residue. When the quantity is large, it results in what is known as "boney coal," generally not marketable, for which reason it is not mined. This ash feature is well illustrated by the Hocking Valley coal seam. Certain benches or strata of the seam are low in ash, while others are much higher. The third group of ash consists of dirt or foreign matter washed in during the deposition of the seam, but in separate and distinct strata. This is illustrated by the different "splits" of the Mammoth anthracite seam of Pennsylvania, which is separated by comparatively thin strata of hard rock. The dirt parting in the Pittsburgh coal seam is a prominent example. Sometimes these partings do not extend over the entire area of a seam; in other cases they are extensive and uniform, as the "blue band," a shale parting from 1 to 2 in. thick in the No. 6, the most important coal seam of Illinois, which extends over the entire known area of the seam.

Dirt Mixed with Coal During Mining

The three foregoing groups of ash are all included in the seam itself. The fourth, however, is from sources entirely outside the seam. It is dirt which gets mixed with the coal during the process of mining, coming from either the roof or the floor. The amount of this ash will vary with the natural condition and the care in mining and preparation. The quantity of the free ash of the third and fourth groups varies through a wide range. In some cases it is practically zero; in others it runs quite high, but in a large measure is corrected by preparation, which consists in removing much of this dirt on picking tables and belts, separation

by spirals and washing, in addition to throwing it out when the coal is loaded in the mine.

As a general rule the quality of coal fuel in the United States, east of the Rocky Mountains, declines from east to west; likewise from south to north. Thus heating power and fixed carbon are higher, and moisture, ash and sulphur are lower in the East. The fusibility of the ash also follows this rule, so that in the East it is lower and more refractory, and in the West there is more ash and it melts easier. The following cases of ash troubles will illustrate in a concrete way the point it is desired to emphasize, and the remedy.

Firing Methods on Ocean Vessels

Ocean ships generally burn semibituminous coal that has a refractory ash. As the coal cakes in burning, it is necessary to break up the fuel bed so as to maintain the required rate of combustion. It is the practice to slice and rake the fire, the bar being run under the fire and then pried up to free and open the fuel bed. When firemen accustomed to ocean practice first go into the fireholds of Lake steamers, they run the bar under the fire and turn it upside down with the ash on top. The ash then melts and runs down through the coal and spreads over the grate, shutting off the air. The result is that the fire ceases to burn, and in about fifteen minutes, the man is "down and out." On the Lakes the fireman who has learned to fire never touches his fire with the tools until it is time to clean it, because he knows if he does there will be trouble with clinker. The coal never cokes, or cakes together, but burns freely. The presence of a salt-water fireman on a Lake steamer is considered to be quite a calamity. He blames the coal and it takes a long time for him to unlearn the supposedly superior ocean method.

An electric plant in Illinois, hand-fired, for a long time used semibituminous coal from West Virginia. It was of an inferior grade, inasmuch as it was high in ash, but the ash did not melt. It was the custom to run from about three in the afternoon until eight at night, over the peak, without cleaning the fires, which was necessary on account of the limited boiler capacity. The fires were frequently sliced and poked to cause the coal to burn fast enough. The slice bar was run under the fire on the grate, then broken up through ashes and out of the top of the fire, mixing fire and ashes together. This practice was continued until cleaning time, so during the latter part of the period slicing was frequent. When the fires were burned down for cleaning, the ashes on the grate were about a foot thick, but there were no clinkers. A change in fuel to Illinois egg coal was made, but the firing method was not changed. The men sliced as before, with the result that the first slicing put the fire out of business, although the Illinois ash content was much smaller than that of the Eastern coal. When the men unlearned the old method and ceased to poke the fire, they found firing much easier than it had been with the Eastern coal.

Clinkering Caused by Poking Fires

An Eastern coal company producing from a bituminous seam with a fusible ash content had difficulty in competing with Pocahontas. When this coal replaced Pocahontas for trial, it was given the same handling with the result that it failed. This led to putting experts on the problem. They did not say that poking would cause clinkering with their coal. What they told the customer was that the use of Pocahontas required much labor which could be eliminated by the use of their product, because it did not require poking and slicing

Some time ago a trial was made in Chicago of one of the new large types of underfeed stoker. It had established an excellent record in the East and there was a desire to know what it would do with Illinois coal, which of course meant screenings. The plant in which it was installed was equipped with chain grates, one of which was removed to give it place. The result was that under test conditions both efficiency and capacity were lower than obtained in regular operation with the chain grate. The forced draft with the underfeed did not give the capacity over a short test period that was obtained with natural draft and the chain grate in everyday service. At the end of the tests the furnace was so full of clinker that it was necessary to cool it down to get the clinker out. This accumulation was due to the fact that it was not possible to dump the grate, so the fire was not cleaned, but run as long as it would before the test was stopped. The fuel used at this plant with the chain grates came from all districts except one which may be designated as X. The screenings from this district carried an especially fusible ash, considered to be too bad even for chain grates.

Use of Steam Jets Prevents Clinkering

Some time later an installation was made in a plant in another city of the same type of underfeed stoker using screenings from the district X. The results reported were most favorable, and the writer was enough interested in the subject to pay a special visit to investigate. The boilers were working at high efficiency at 200 per cent. of rating with no clinker trouble, and the secret lay largely in the method of operation. A ⅜-in. perforated steam pipe lay along the grate surface in the corner up against each side wall. Steam was discharged from the holes in this pipe, cooling the wall enough to prevent the clinker from sticking. Trouble at the dump grate was avoided by not allowing the fire to extend far enough back to keep the clinker on the dump grate hot. If it showed a disposition to get along, the back air supply was used to burn it off. In fact, the clinker and ash on the dump grate were never allowed to accumulate to such an extent that they came in contact with the back wall of the furnace. For this reason clinker could not adhere to the wall and obstruct the operation of the dump grate, even if it did remain hot. Care was also taken to see that the grate was dumped before the accumulation became too large to be handled easily.

Sometimes the clinkers were so large that they would not drop through the openings when the grate was dumped. In such cases they were readily broken up with a bar through the side door, because they were cold and brittle. Here was a case offering maximum opportunity for trouble, a form of stoker possessing maximum possibilities for clinker production, and one especially subject to grief from utilizing a fuel containing the maximum amount of clinker-forming material, yet doing so with the minimum amount of trouble. This was because the men operating the plant, instead of concentrating their thought on how to burn such bad coal, gave atten-

tion to the problem of handling the ash, with the result that the coal took care of itself.

In changing fuel, the fundamental difficulty is that the operatives attempt to employ the same methods with the new fuel that they have used with the old, like the salt-water fireman on the Lakes. In changing from a low-ash to a high-ash coal, they are liable to allow the same time interval between fire cleanings with the result that there is such an accumulation that it cannot be disposed of. They also fail to take into consideration the difference in the fusibility of the ash and to study remedies to cure the troubles likely to result from this cause.

With stokers, if more ash must be handled, either the discharge opening must be enlarged or the quantity of material handled at a cleaning should be reduced. As the latter is easier it implies more frequent cleaning of fires, which also operates to reduce clinkering, and the smaller the amount of ash present, so is the tendency to fuse. Some forms of stokers have a fixed and continuous ash discharge. If the capacity of this feature is designed to fit a low-ash fuel, it will not be adequate for high-ash fuel. Some of these ash-discharge features are independent in operation, in which case they may be speeded up. In other cases, with a fixed opening, it may be necessary to enlarge the ash exit.

The New Coppus Turbo Blower

An undergrate blower is subjected to severe working conditions because it operates in an atmosphere of dirt and dust and is often under the care of unskilled men who give it scant attention. With these facts in mind, the manufacturers of the Coppus blowers have developed Type C, shown in Fig. 1, and have made

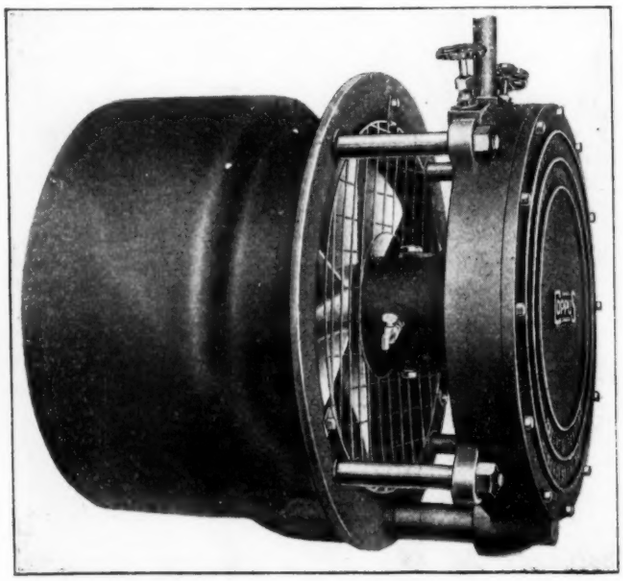


FIG. 1. TYPE C TURBO BLOWER

it as nearly proof as possible against dust, neglect and abuse

The construction is shown clearly in Fig. 2. The casing *A*, containing the turbine wheel by which the fan is driven, is supported from the fan casing *B* by studs *C* and the exhaust pipe *D*. The shaft *E* to which the turbine wheel and the fan are keyed is carried in ball bearings that are mounted in a removable bushing *F*. This bushing, which is closed at the ends, is inserted into the housing of the turbine casing and thus forms the oil chamber *G*. The oil ring *H* hangs from the shaft and dips into this chamber, from which the oil is carried up and distributed to the bearings. The turbine casing is sealed so that no steam or water can

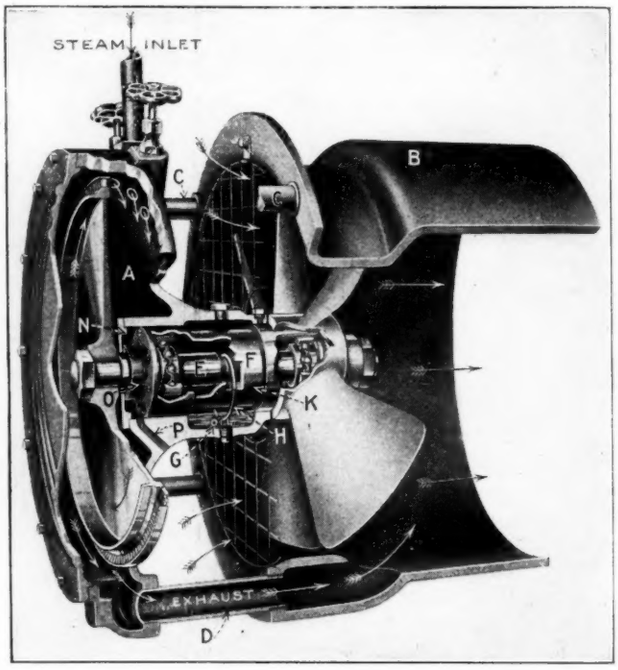


FIG. 2. PART SECTION SHOWING CONSTRUCTION

leak into the oil chamber and the oil chamber is sealed against leakage of oil.

As the life of a machine depends very largely on the excellence of its lubrication, especial care has been taken with the oiling arrangements, which are shown in greater detail in Fig. 3. The oil ring *H* takes oil from the chamber *G* and carries it up into the V-shaped groove in the shaft. Because of the shape of this groove, the oil is distributed toward the ball bearings at the ends and is thrown off in their direction. The excess oil runs down inside the bushing *F* and collects on each side of the dam *I*, which forms two oil chambers. From these chambers the oil flows by gravity to the ball bearings, passes through and is led by the channels *J* to the oil chamber *G*. By using the dam *I* both bearings are sure to receive oil even if the blower is not exactly level.

When the oil chamber is filled, the oil stands at about the level of the centers of the lowest balls. The oil ring raises considerably more oil than the channels *J* can carry away, and so the bushing is provided with overflows, one of which is shown at *K*, Fig. 2. The oil reservoir is filled through the opening made by removing the plug *L* and may be emptied for cleaning by removing the plug *M*.

It will be observed that the shaft and its bearings are not mounted directly in the turbine casing. This is done to avoid wear on the casing, which would then need to be rebored or bushed. Instead, the removable bushing is used, and thus repairs can be made quickly and cheaply, inasmuch as the various parts of these blowers are made so as to be interchangeable.

No stuffing-boxes are used, thus eliminating a possible source of friction and loss. By the construction, the discharge of steam from the turbine casing needs to be sealed at only one point, namely, where the shaft passes through the cover *N*, Fig. 2. At this point is a solid carbon packing ring *O* that is steam-tight on a ground section of the shaft and needs neither lubrication nor adjustments. It is pressed against the cover *N* by springs on the end of the removable bushing and is prevented from turning by a pin in the cover *N*. If any vapor should chance to leak past this packing ring, it would enter the chamber between the cover *N* and the end of the bushing, from which it would escape to the atmosphere through the passage *P*, which is always open.

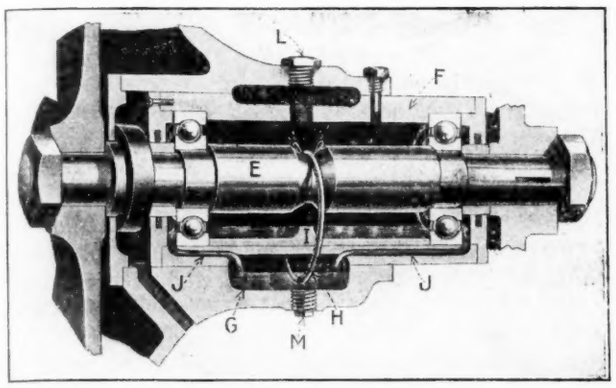


FIG. 3. SECTION SHOWING OILING ARRANGEMENTS

The exhaust steam from the turbine is led through the pipe *D* to a point beyond the fan, so that the steam is carried into the ashpit with the air, thus cooling the grates and reducing the formation of clinker. If it is desired to convey the steam away from the blower entirely, the pipe *D* is replaced by a fitting that is closed toward the fan and that leads the steam from the turbine casing through an elbow to the exhaust pipe. If only a part of the steam is to be sent into the ashpit, the fitting shown in Fig. 4 may be used. It consists of a sleeve inside of which is a rotatable shutter operated by the handle at the front. The position of the openings in the end and side of this shutter determines the relative amounts of steam sent to the ashpit and discharged to the outside.

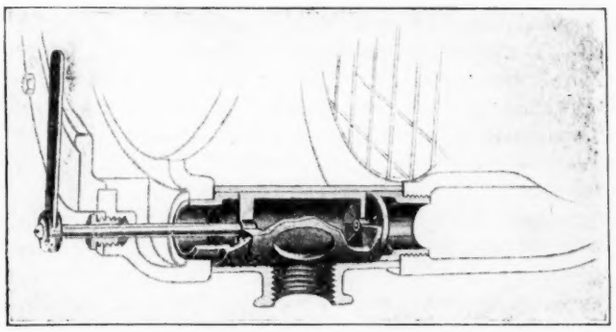


FIG. 4. SLEEVE VALVE FOR DIVIDED EXHAUST

The fan casing hugs the fan closely but is expanded toward the ashpit so as to relieve any choking effect on the air and so prevent eddy currents and consequent friction.

The Type C blower is made by the Coppus Engineering and Equipment Co., Worcester, Mass.

Care of Heating and Ventilating Equipment—I

By HAROLD L. ALT

The first of a series of articles on the economical operation of heating and ventilating equipment. Importance of selecting the proper system. A job that is cheap to install is likely to be expensive to run. Every operator should endeavor to cut down coal consumption. Direct and indirect systems.

THE economical and satisfactory operation of the equipment for any building is dependent upon three things—suitable apparatus, proper installation and proper handling or care—as the failure of any one of the three to meet the requirements will produce uneconomical results. A building equipment therefore may not function properly for several reasons. What is meant by "properly operated," and how does one know if a building is so handled? In reply it may be said that proper operation consists in producing the maximum of satisfactory results with a minimum expenditure of money, labor and material, but it is impossible to say with positiveness when such a result is reached. If, however, a building is run, furnishing equal service, with 10 per cent. less coal during an average year when in charge of one engineer than when in charge of another, it is undoubtedly true that the latter is not operating properly, but it is always a question whether the best or maximum efficiency is being attained. Besides, there are many variables to be considered in such a comparison, and to prevent doing an injustice great care must be exercised to see that equal service is furnished in each case. A thousand-and-one things cause a difference: The coal may run better or poorer; the seasons may differ; there may be a greater or less portion of the building in service, for longer or shorter hours; the condition of the installation, within the control of the owner alone, may be different, affecting its efficiency. The operating engineer should not always take the whole blame for poor results. There are, however, certain basic principles that govern the running of any plant, and the degree of efficiency depends on whether the engineer is applying these principles or is ignoring them, either through lack of knowledge or from pure indolence.

The performance of a building plant is influenced by the original design and installation. In heating and ventilating, the most important consideration is the selection of the proper system (or the one of several good systems) in order to make successful manipulation by the operating engineer possible. If a proper system of heating is not originally selected and instead one with

certain inherent weaknesses is put in, the operating engineer can do little to correct it, and a properly designed system, if furnished with cheap and undependable apparatus, is also beyond the help of the operating engineer as long as the unsatisfactory equipment remains. True, he may replace such equipment more easily and at relatively less cost than an entire heating system can be pulled out and reconstructed in altered design, but even a change so simple as the substitution of good radiator traps on a vacuum system in place of ones that are not satisfactory will cost from $7 to $10 per unit and soon amounts to considerable expense. Much money and many of the troubles of the operating engineer may be saved if the owner can be convinced at the time of installation that the job that is cheap to install is likely to be expensive to run, and that worthwhile apparatus sells for the highest prices simply because experts know its value and true economy in the long run. It is a fact that many plants, especially in older buildings, are not well equipped and therefore, in spite of additional attention and effort expended by the operating engineer, the results cannot be as satisfactory as in buildings where the original design is similar but only first-class equipment is used.

Many Satisfactory Systems Available

It must not be taken from the foregoing that any one heating system or device is necessarily the only satisfactory one for a given set of conditions, because in heating and ventilating there are many ways of accomplishing the same end. Some are particularly satisfactory under certain conditions, others give fair service, while still others may have serious shortcomings. It is encouraging, however, to note that the modern building is much more carefully designed as to its equipment than the building of even ten years ago. While heating and ventilating equipment is much improved both in variety and quality, it is highly developed by only a few, fully understood by a small minority and only feebly appreciated by the general public. It should be remembered that while a power plant utilizes only 8 to 15 per cent. of the energy contained in the coal burned, a heating plant uses about 75 per cent. during the winter. When a combination power, refrigerating and heating plant is in use, the energy rejected by the power plant is not allowed to escape with the exhaust, but is caught by the heating or refrigeration plant and utilized. Therefore the production of power without heating in combination is little short of criminal, while on the other hand the operation of a large heating plant without the production of the by-product power is wasteful.

Engineer Should Endeavor to Get the Best Results Possible

The average engineer who is not getting the best results possible with his plant at the present time, is an unpatriotic slacker. While it may not be possible or practical to make his plant over, if he is wasting coal when such waste is preventable, he is wasting his own energy shoveling the coal and wasting the owner's money. It is not going too far to say that he is also wasting the coal and railroad companies' time delivering fuel he does not need, is robbing some other consumer, and, like many others, is helping to unnecessarily overload the railroad systems and thus delay that vitally important factor, transportation. Every operating engineer should do his bit by cutting down the coal consumption in his plant to some extent—the greater the better. The operating engineer to make a success of his work must be thoroughly familiar with the building and plant under his charge, must study conditions every day, and the best days for this purpose are the coldest ones. He must know at what hour in the morning he should turn on heat to have the rooms comfortable when required, must know how much earlier this is necessary when the wind is blowing, etc. Above all, at the present time, he must avoid overheating—underheating is uncomfortable, but overheating is waste. Of course the engineer must maintain the temperature that his particular building or portions of a building demand, but for ordinary purposes the Government and the heating and ventilating engineers agree that 68 deg. F. is high enough.

Heating systems in general are divided into two main classes, direct and indirect, the first having radiators placed in the room or section to be heated, and in the second the heating is done by air heated and conducted to the room from some more or less remote point. Each class and type of heating system will be taken up in later articles and its practical operation explained, but it should be borne in mind that there is more to successful operation than the simple understanding of the underlying theoretical principles involved in the particular system in question. Before taking up in detail the discussion of the several classes of heating systems and how they should be operated, it is thought advisable to consider the boilers, the heart of every independent heating system, for on their proper installation and firing largely depends the results obtained with a given system.

New York Power Concerns Must Specially Incorporate

Under the laws of New York, suit lies at the instance of the Public Service Commission to enjoin a manufacturing company from engaging in the business of selling electric power to the public, where the company has not been incorporated under the Transportation Corporations Law and has not acquired permission from the commission to exercise a franchise to distribute power. In so holding, in the case of Public Service Commission vs. J. & J. Rogers Co., 170 "New York Supplement," 964, the New York Supreme Court at Albany said:

> The question is simply this: Can a manufacturing corporation, organized as such, and doing business as such in large volume, assume in a small way to do an electrical business which is in violation, not only of the spirit, but the very terms, of the statutes? If it is a manufacturing corporation, it cannot do an electrical business. If it is an electrical corporation, organized for that purpose, it cannot begin to transact business until its application meets with the approval of the Public Service Commission.

From January, 1915, to the end of May, 1918, 407 ships sunk by the Germans in British waters have been salvaged, according to details of the work of the admiralty salvage department. Up to December, 1917, 260 ships were recovered. In the present year to the end of May, 147 were salvaged, the increase being due to improved methods and not to greater activity of U-boats.

Induction-Motor Troubles—II

By GORDON FOX

Consideration is given to the troubles occurring within induction motors. These troubles are classed and discussed under two heads, mechanical and electrical.

INDUCTION-MOTOR troubles occurring within the motor itself may be classed as mechanical and electrical. First will be considered mechanical troubles. There being so few mechanical parts to an induction motor, about the only frequent mechanical troubles are hot or worn bearings, unbalanced or sprung shafts. Bearings may run dry and seize the shaft, or they may run with excessive friction, overloading the motor perhaps and heating up the bearing. More commonly, the bearing, particularly at the pulley or pinion end, wears away, making the air gap unequal and finally permitting the rotor to rub the stator. This is one of the most common induction-motor troubles and one that must be guarded against by frequent inspection.

Eccentricity of the rotor of an induction motor may or may not be serious in itself, aside from the small margin of safety in the matter of clearance. It is the tendency of a squirrel-cage rotor winding of low resistance to allow corrective or balancing currents to flow, which prevent distortion of the magnetic field and hence prevent a tendency toward unbalanced magnetic pull. In a wound-rotor motor arranged for high starting torque, the secondary resistance is comparatively high and the balancing currents are obstructed to some extent, allowing unbalanced magnetic pull, which produces vibration and noise and in some cases actual striking of the rotor on the stator. If the primary windings of each phase of a motor are paralleled so that each circuit contains coils symmetrically located, balancing one-half of the circumference against the other half, the tendencies toward unbalanced magnetic pull are reduced. It is common practice, for instance, to connect the N poles of one phase in one circuit and the alternate S poles in another circuit, each set being grouped around the entire circumference, as in Fig. 1, which shows a six-pole parallel-delta connected winding.

Faults in the windings of an induction motor may occur either as a development in the operation of a normal motor or as defects or errors in winding, reconnecting or repairing it. The faults which may develop in the primary winding of a normal motor in operation are short-circuits, open-circuits or grounds. Short-circuits may occur between turns in a coil, between coils in a phase or between phases. Short-circuits between coils or phases will usually be quite severe and their location easily found. They must be cleared before operation may be resumed.

A short-circuit between turns in a coil might not cut out sufficient turns to affect the operation of the motor. It will, however, create a local short-circuit containing a few turns. The constantly reversing primary flux will induce voltage in these turns and a heavy current will flow, which will quickly heat up the affected coil or coils. It is thus seen that a condition of this kind is evidenced by severe local heating, likely to cause the faulty coils to smoke and their insulation to char. The best remedy for such a fault is to remove and replace the defective coil or coils before the rest of the winding is overheated and damaged. If the motor must be kept in operation while preparations are made for such repairs, or until time is available for the work, it may be possible to take temporary measures to relieve the difficulty. If the winding is series-star connected, it may be possible to open-circuit and cut out one or more coils, placing a jumper around them. The current in the three phases will be unbalanced and efficiency and power factor will suffer and there will be increased heating, but the motor may operate satisfactorily, particularly if the load is light. There will be some distortion of the magnetic field, this condition always tending to noisy operation. It may be better to cut out three coils, one the defective coil, the other two being corresponding symmetrically located coils in the other two phases. This will result in a balanced winding operating with a slight overvoltage.

If the winding is connected multiple-star, series-delta or multiple-delta, the unbalancing incident to cutting out a coil in one phase or circuit alone will be much more severe and the heating will be pronounced. It may be possible, in a multiple-star winding, to cut out two coils—one the defective coil, the other a corresponding symmetrically located coil in the other multiple circuit of the same phase. This procedure will be

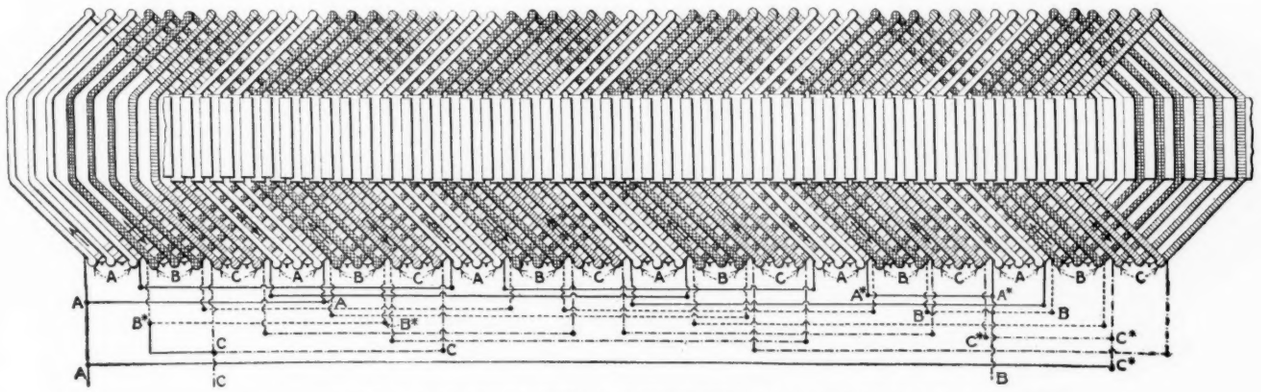


FIG. 1. SIX-POLE, PARALLEL-DELTA CONNECTED INDUCTION-MOTOR WINDING

satisfactory only if there are a number of coil groups in series in each multiple circuit so that the phases will not be unduly balanced. In a series-delta winding it may be possible to cut out three coils, one the defective coil, the other two being corresponding symmetrically located coils in the other two phases. This procedure will be practically equivalent to raising the terminal voltage of the machine and will be satisfactory provided the motor is not overloaded and not more than one-tenth of the coils are cut out and these coils are properly selected for mechanical symmetry around the bore of the stator.

In the case of a multiple-delta winding it will be necessary, if one defective coil is cut out, to also cut out and jump around five other coils, in a two-circuit per phase winding. If there is more than one defective coil in the same circuit of a two-circuit per phase winding, it would be necessary to cut out an equal number of coils in the other circuits, or if there are more than two circuits per phase, an equal number of coils must be removed from each circuit to maintain a balanced condition in the winding. These latter conditions are therefore almost prohibitive for temporary repairs. It should be borne in mind that when coils are cut out and replaced by jumpers, as already described, the ends of these coils must be carefully separated and taped. Although they are removed from the primary circuit, they will have voltages induced in them. When a short-circuited coil is cut out, the turns should be thoroughly open-circuited to eliminate all local currents; this is done by cutting the coil in two.

An open-circuit within a series-star winding will disconnect one phase and cause the motor to run single-phase. An open-circuit in a series-delta winding will

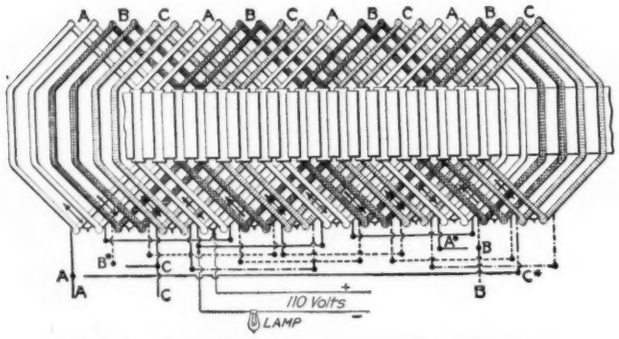


FIG. 2. SERIES-DELTA CONNECTED WINDING

permit the motor to operate open-delta with a distorted field. The motor will not be capable of developing its full power, will run at a reduced speed, and will be noisy in operation. An open-circuit in a multiple winding will distort the magnetism and cause the motor to operate poorly, if at all. Open-circuits may often be quickly remedied, being more frequently in the connections than within the coils. If a coil is defective, it may be cut out and replaced by a jumper as with a short-circuited coil.

A single ground in an induction-motor's primary winding will not affect the operation of the motor unless there be other grounds on the system. It is well, however, to clear a ground as quickly as possible before trouble develops. If a grounded coil cannot be cleared or readily renewed, it may be disconnected and replaced by a jumper as with other types of defective coils.

Various mistakes may be made in the primary connections of induction motors when they are repaired, rewound, or reconnected for change in voltage or otherwise. The more common mistakes are short-circuits, open-circuits, reversed coils, wrong grouping or wrong connecting. It is quite easy to short-circuit a coil by unintentionally connecting its two leads together. Sometimes a group of coils or entire phase may be short-circuited owing to error in connecting. Short-circuits of this kind will cause trouble much the same as those arising from breakdowns.

Open-circuits may easily occur by missing a connection at some point. It is possible for a joint having a

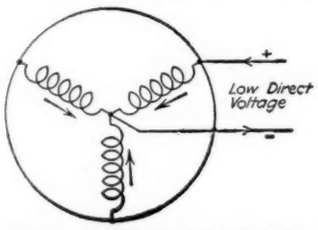


FIG. 3. METHOD OF CHECKING STAR-CONNECTED WINDING

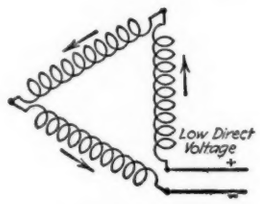


FIG. 4 METHOD OF CHECKING DELTA-CONNECTED WINDING

poor connection within to be taped up, causing considerable annoyance. A motor open-circuited in this way will probably refuse to start, as already described.

Reverse connections are frequent offenders. A single coil may easily have its ends interchanged in connecting. A phase group may quite readily be reversed, and the reversal of a complete phase is a frequent occurrence. Reversal of a single coil may not prevent the motor from operating, but it will reduce its power and cause it to run noisy and at an increased temperature. Reversal of a phase group will greatly aggravate conditions, and may prevent the motor from starting. With an entire phase reversed, the motor may start, but it will not come up to speed. Wrong grouping, such as the inclusion of too many or too few coils in a group, may occasionally occur. If the error affects but a few coils, the motor may operate, although it will draw an unbalanced current and operate with increased temperature and noise.

Wrong connecting may include either the connection for a voltage other than that applied or connection in star instead of delta or vice versa. If the motor is connected for a voltage higher than that applied, or if connected star instead of delta, it will be lacking in torque. If the motor is connected for a voltage lower than that applied or if connected delta when a star connection is correct, it will run hot, even without load, owing to the excessive magnetizing current. The no-load current of a normal induction motor should range from 20 to 40 per cent. of the full-load current, and the no-load watts input should be about 8 per cent. of full-load input.

Sometimes the location of a fault is evident, as in the case of a short-circuited coil which runs hot or a ground which arcs or betrays its presence through the odor of burnt insulation. The simplest test for short-circuits is that of running the motor and watching or feeling for locally heated coils. An open-circuit in a series-star winding can be found by the use of the test lamp without opening up the star connection. Sharp-pointed terminals are used, as in Fig. 2, to penetrate

through the insulation at the end connections. With a delta or a multiple winding it is necessary to open up the phase or multiple connections, as otherwise the test current will be shunted around the open-circuit and the lamp will always test bright. Fig. 2 shows a series-delta winding with each phase disconnected to prevent the test current being shunted around the defect. The presence of a ground may be shown by a test lamp. In order to definitely locate a ground with a test lamp, it is necessary to disconnect the different phases, then locate the defective phase, and afterward locate the grounded coil by dividing the defective phase into sections and testing each section.

In rewinding or reconnecting a motor, checks for correctness should be made before the motor is reassembled. Test for grounds with a test lamp. In case of a new winding a high potential test from windings to frame should also be made. If the winding is clear, the resistance of each phase may be measured, doing this in case of a delta-connected winding, before completing connections. If the resistances differ, a short-circuit or an unequal number of coils is indicated. The accuracy of the winding may be further checked by impressing a low alternating voltage across each phase individually and measuring the impedance of the phase (impedance = volts ÷ amperes). Too many coils in the phase increase its impedance and too few coils decrease its impedance. Reversed coils decrease the flux, hence decrease the impedance. If the phases measure of equal resistance with direct current but have dissimilar impedances, it is probable that a coil or coils are reversed in the low impedance phase. A short-circuited coil will show up on the imepedance test by running warmer than the others in the group.

Checking Connections by a Compass Test

The correctness of the connections can well be checked by a compass test. If the winding is star-connected, all the leads should be connected together and to one terminal of a low-voltage direct-current source, the other terminal being connected to the neutral of the winding, as in Fig. 3. If the motor is delta-connected, the winding should be opened at one lead and connected as in Fig. 4. In either of these cases, if a compass be passed around the stator bore, it should indicate three times as many poles as the rated number for the motor, these poles being equally spaced and alternately N and S. If an individual coil is reversed, it will tend to reverse the compass when directly over that coil. If an entire pole-phase group is reversed, there will be three successive like poles at that point. If an entire phase is reversed, there will be only as many N and S poles as the rated number for the machine, these poles alternating, each pole covering a zone of three pole-phase groups.

Troubles may arise in the rotor windings as well as in the stator. In the previous article, June issue, the case of a wound rotor having a poor connection or an open-circuit in the external circuit, was considered. If these troubles arise within the winding instead of in the external circuit, their effects are the same. More often, however, the faults are outside the motor.

The possible errors in connecting induction-motor primaries may also occur in the case of the wound secondaries, and the same tests and checks should be made. The rotor windings of induction motors are nearly always three-phase and star-connected. The resistance and impedance tests may be used to check the equality of the phases, and the polarity test will check the phase relations and detect any irregularities. It should be borne in mind that the voltage in a wound rotor is quite high and insulation comparable to that of the primary windings must be maintained, since the winding must be insulated.

The squirrel-cage rotor is of rugged construction. Its vulnerable point is due to the fact that it carries high currents at low voltage and has to dissipate the slip energy of the motor. It is somewhat difficult to maintain connections between the rotor bars and the end rings. Formerly, these connections were made by soldering. It was then a common occurrence for the solder to be melted out. High-resistance end rings are commonly connected to the bars by bolts provided with spring washers which maintain uniform tension and uniform contact. In case of trouble these bolts or their washers may be at fault. The effect of poor contacts in the rotor circuit is to greatly increase the rotor resistance, causing the motor to drop in speed, decreasing its maximum torque and reducing its starting ability, if sufficiently severe. The rotor will run hot under these conditions. Most modern rotors, except in the smaller sizes, have the end rings brazed or welded to the bars so that little trouble arises from poor connections.

It may be said in passing, that grounds in a squirrel-cage winding are ordinarily of little importance. The voltage is so low that little current can be shunted from the low-resistance squirrel-cage winding into the higher-resistance circuits through the iron.

Palmer Forced-Draft Burner

With the high price of fuel and the probable shortage of coal this winter most engineers are especially interested in grates and furnaces that aim to reduce the cost of operation. Strange as it may appear, there are many

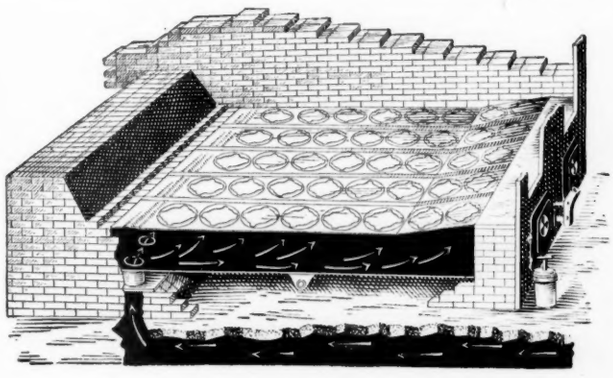


FIG. 1. THE FORCED-DRAFT BURNER

boiler plants operated today with the same methods that were employed twenty years ago.

In recent years many types of furnaces have been perfected, each having some distinctive feature. A furnace setting that has been on the market for about ten years but not generally well known is the Palmer forced-draft burner, manufactured by the Palmer Forced Draft Slack Burner Co., Ft. Scott, Kansas.

This system, Fig. 1, consists of a set of burners and

a blower. The burner is hollow and air is forced through it into the furnace. The burners take the place of the ordinary grate bars and are made to fit close together and form a surface so that no fuel can fall through into the ashpit.

Air is supplied to the rear end of each burner at the bottom and passes through the hollow interior to the

FIG. 2. A SECTION OF THE BURNER

burning fuel through circular plates on the top of the burner, as shown in Fig. 2. Around the edge of each plate or tuyere is an air space about $\frac{1}{8}$ in. in width, but varying for different classes of fuel. The air spaces are beveled, so as to spread the air as it emerges from the burner. By this arrangement air is practically brought into contact with the fuel instead of being forced through it before a proper mixture of the air and liberated gases has been made. No air enters the furnace from any other source. Fine ashes and dust that sift through the tuyere opening at the time of cleaning the fires are removed by opening slides in the bottom of the burners, Fig. 3. The slides are operated by a lever on the front of the furnace setting. The slides are also used for admitting air to the burner when getting up steam on a dead boiler before there is sufficient steam to operate the blower. An automatic regulator increases or decreases the air supply as the steam pressure drops or rises.

Air is conducted from the blower to the furnace by ducts, either beneath the blower or overhead, as occasion demands. If more than one boiler is used, the main air duct is extended so as to reach all boilers in the battery. From the main duct connection is made to a lateral duct beneath the back end of the burner and a separate connection made there to each section of the burner, each burner getting its own air supply independent of the others; see Fig. 1.

In installing this device it is only necessary to remove the ordinary grate bars and put the burner in place, the design of the furnace and burner area being such as to meet the conditions in any plant.

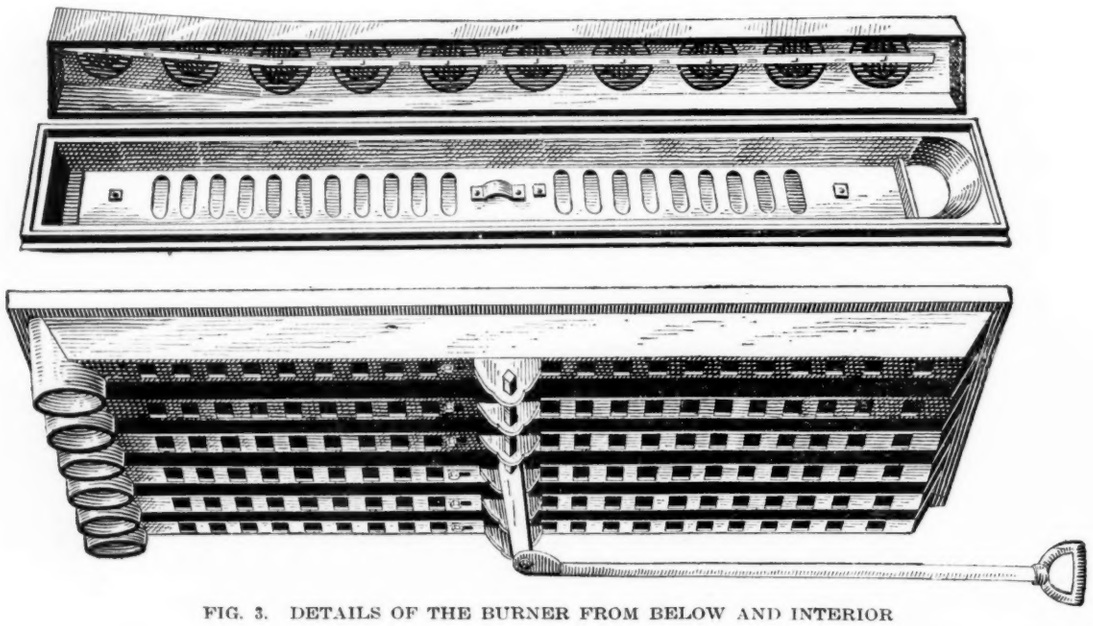


FIG. 3. DETAILS OF THE BURNER FROM BELOW AND INTERIOR

Buying Equipment

When power equipment or rather machinery is sold under an agreement binding the buyer to inspect it before shipment, he will not be entitled to rescind the purchase or recover damages because the equipment proves to be of different kind than that bargained for, if he has induced the seller to ship on an assumption that the equipment has been inspected. But a mere failure on the part of the buyer to inspect, without the buyer representing to the seller that inspection was made, would not preclude him from asserting that a different kind of engine or other machine was shipped than was contracted for, although, if the engine or machine was of the kind bargained for, failure to inspect would waive any claim on account of defects in quality or condition which could have been readily discovered on an inspection. These points were decided by the Alabama Supreme Court recently in the case of J. F. Donahoo Co. vs. Reliance Equipment Co., 78 Southern Reporter, 800, in which it was objected that an 8 x 10 log skidder was shipped on an order for a 6 x 10 hoisting engine.

War Bars Extension of Lighting Plant

No further extensions will be made in the Cleveland municipal lighting system until after the war, Lighting Commissioner Davis announced recently. This means that the plant can take on no new customers unless a wire passes directly in front of the applicant's home.

It is understood that $200,000 is left of the $1,500,000 bond issue passed nearly two years ago and this is to be used for improvements at the plant.

Need and Value of Boiler Inspection

By A. L. G. TAYLOR*

The writer, from his long experience as a boiler inspector, cites some strange instances of unsafe conditions revealed by inspection, and draws the inevitable conclusions.

IT IS questionable whether many defects that occur in the operation of steam boilers would be discovered, until too late to be remedied by simple methods, except by the visit of the boiler inspector. For, apart from the fact that he is trained both by knowledge and experience to look for them, it should be recognized that he is a specialist in his particular line and when he makes an inspection his mind is concentrated on his immediate task. On the other hand, the engineer in charge who tries to carry out an inspection is subject to numerous distractions in connection with his regular duties, and as a result some matters are likely to escape observation.

Too often there is a lack of hearty coöperation on the part of the owner or engineer toward the inspector, and this sometimes manifests itself in deliberate antagonism. The cause may be disinclination to incur any additional expense, as in the case of the owner who objected to the removal of a manhole cover from a boiler to facilitate inspection, on the ground that a gasket would be needed to make up the new joint, despite the fact that the cover had not been removed in a year.

Indifference of Owners and Engineers

In other instances the engineer or owner may affect indifference toward the existence of dangerous conditions. A certain electric-light plant contained a battery of four Babcock & Wilcox boilers, of which only three were working when the inspector arrived. The steam gages registered a pressure of 125 lb. per sq.in., and the inspector was about to test the water gages when he noticed a difference in level of about six inches in the glasses of two of the boilers (each of the boilers having two drums) and could see no water in one of the glasses of the other boiler.

After testing to see whether the connections were clear and finding that they were, the inspector asked that water be pumped into the third boiler until water showed in the glass then empty. Water was pumped in until one glass was full and on trying the water-cock at the bottom of the other glass, dry steam still issued. The engineer was asked whether this condition had not caused him some worry. He admitted that it had, at first; but as the boiler had been like that for some time and nothing disastrous had happened, his fears had somewhat abated.

The inspector had the boiler put out of commission immediately, removed the caps from some of the headers and found the circulating tubes at the rear of the boiler plugged practically solid with scale. This was removed, and when the boiler was refilled the water level in both glasses was the same. It appeared that all the attention to cleaning had been confined to the bottom rows of tubes and the circulating tubes evidently had not even been examined. How long this would have continued if the inspector had not paid his visit it is impossible to say.

Two horizontal return-tubular boilers had been installed in a bank building and each had been tested under water pressure by the heating contractors and left ready to be put into commission. Before the boilers were fired the inspector arrived, and during his examination he found that screwed plugs had been fitted into the safety-valve discharge openings during the hydrostatic tests and had not been removed.

Blowoff Cock Burned Off

In another case an inspector called to make an external inspection of a horizontal return-tubular boiler in a creamery. He looked for the blowoff cock in the usual place at the rear of the boiler setting, but was unable to find it. On inquiring of the engineer he was told that it was in the combustion chamber. The inspector pointed out the fact that it could not be opened while the boiler was in operation. "Moreover," he said, "it will burn out." "Yes," replied the engineer, "I know that. In fact, one did." "And what did you do?" asked the inspector. "I put in another, in the same place."

In a wholesale warehouse building was a horizontal return-tubular boiler that an inspector attended for the purpose of complete internal and external inspection. On looking under the shell from the fire-door, he noticed that the shell plates were covered with a thick layer of soot. He remarked that it was impossible to inspect the boiler thoroughly in that condition and required the soot to be cleaned off, when it was found that the layer was about two inches thick. The boiler attendant protested that the cleaning was unnecessary, as no one had been under the boiler in seven years, and accused the inspector of being particularly fussy. Since that time he has learned what boiler inspection means, and is now only too pleased to get his boiler ready whenever required to do so.

In another warehouse building the inspector found a single boiler to be inspected. He asked the attendant how the boiler was working. "All right today," said the man. "But I had some trouble yesterday. I couldn't get water to show in the glass." "What did you do?" asked the inspector. "Oh, I shut the steam valve on the top of the gage-glass, and then the water showed all right." This man was given another job.

On another occasion the inspector called to examine two locomotive-type boilers in a large life insurance building. On entering the firebox of one of them, which was equipped for burning gas, he observed that in addition to the brick arch and baffling arrangement the crown of the firebox was filled with hard cement about two inches thick. He was at a loss to account for this and asked the engineer to explain. The engineer did not know what it meant and so the inspector called up the heating contractor that had installed the boilers and asked him to explain. The contractor was greatly concerned about it, and made an investigation. It then was discovered that while the building was under construction the boiler was lying upside down and that the cement had fallen into the firebox by accident and had

*Resident Inspector for the Boiler Inspection and Insurance Company of Canada, at Winnipeg, Canada.

solidified there. The boiler had been erected and was to have been put into operation the day after the inspector unexpectedly arrived.

These are only a few examples of the conditions that inspection reveals, but they show that the need of inspection is imperative. Owners of even the most efficient and well-kept plants are fully aware of the wisdom of periodical inspection, and they are only too pleased to accept the advice and recommendations of the inspector. They recognize that it is to their interest to discover defects that, if they did not entail a heavy money loss through a disaster such as an explosion, might lead to expensive repairs if they were left undiscovered. Thus the timely advice of the inspector would save many times the cost of efficient inspection.

Watching the Steam Plant

By P. R. Duffy

The boiler plant may be considered as the prime factor in power equipment wherever the steam engine or turbine is used to produce power, and in the past this department was, and in many plants is yet, the most neglected part of the equipment and the most costly to operate. This is because it receives no more attention than is absolutely necessary, and the practice of employing cheap labor to run it is one of the main sources of evil. There is not a department in any plant that should receive closer attention, and there should be a competent head so that the most economical use of high-priced fuel will be obtained. Investigation should begin with a determination of existing losses and should be carried on with such thoroughness that the exact location, cause and extent of the preventable losses will be shown.

A great many questions may arise in the boiler plant as to contemplated changes in operation or in equipment. If such considerations were properly regarded during the design of the plant, there would be more plants operating with less preventable waste than at present.

It is common in the neighborhood of factories, power plants, etc., to observe clouds of black smoke and waste steam issuing forth. This means preventable waste. Many cities have laws compelling all steam plants to provide means to do away with this evil. A progressive manager would for the sake of economy eliminate all preventable wastes and not wait to be compelled by law to do so.

In order to get good results it is necessary to see that the boilers are kept clean, the settings free from leaks, the tubes properly baffled, the furnace equipped for maximum efficiency, and the feed-water lines free of scale and of proper design.

The temperature of the feed-water supply to boilers is important. It is the general practice to install a feed-water heater using exhaust steam from the engine and pumps as a heating agent. The water will enter the heater at, say 60 deg. F., and the temperature is raised to 100 deg. F.; in most large plants the water is forced through an economizer using waste gases from the boiler tubes as a heating agent, whereby the temperature of the water is raised from 100 to, say 260 deg. or more, depending upon the conditions.

The feed water has been heated, say 200 deg. and each pound of water thus delivered to the boiler has received about 200 B.t.u. more heat than by pumping at its original temperature. Assuming that the boiler pressure is 125 lb. per sq.in., the heat required to make a pound of steam from the original temperature of 60 deg. is 1164 B.t.u. Therefore, we have saved $200 \div 1164 = 17$ per cent. of the heat that would have been required for the generation of the steam from 60-deg. water, and this saving is directly reflected in a corresponding reduction of coal consumed. Approximately 1 per cent. of the coal is saved for each 11 deg. rise in feed-water temperature, provided this is accomplished by heat that would otherwise be wasted.

Not only is a saving made in heating the boiler-feed water, but the method of firing and handling the coal is also important. Hand-firing of boilers is fast giving way to mechanical stokers, and it pays to have suitable stokers in all power plants of, say 200 hp. boiler capacity and up as the cost of labor is reduced and the saving on coal, if intelligence is used, will pay for the ordinary type of stoker in a short time, whereas hand-firing is generally more or less wasteful no matter how efficiently the plant is operated.

There are various types of mechanical stokers, and it is safe to say that in the bituminous-coal region the underfeed type with forced draft is one of the most efficient; the chain grate and other types, however, are also extensively used and with excellent results where the boilers are properly loaded. Any stoker gives its proper efficiency when a boiler is being forced at certain percentages over its rated capacity, and this can be readily determined by tests for each plant.

The coal should be handled to the boiler room with as little cost as possible, and this can be done by various suitable conveying apparatus. The chutes to each stoker should be provided with a cutoff door, the fireman regulating his fuel supply thereby as needed. It is well to provide a suitable weighing device whereby the coal used per hour, day or week can be accurately determined.

The ashes and clinkers should be disposed of as quickly and as cheaply as possible. This matter naturally has to be worked out to suit general conditions and situations. There are several air and steam-jet as well as mechanical conveying devices on the market, and each in its place soon saves its cost in labor alone.

After subjecting the plant to a thorough investigation and making changes in operation and equipment that tend toward better efficiency and the elimination of preventable wastes, we are confronted by the necessity of maintaining a permanent high efficiency to prevent the boiler plant in parts or in whole from falling back to the usual rut.

In order to keep well posted along this line, a simple yet comprehensive system must be installed by which an accurate daily or weekly record of the amount of fuel burned, weight of the feed water evaporated, temperature of the feed water and the steam pressure carried, is available. Along with this report should be one giving data as to the conditions of boilers, stokers and pumps and other miscellaneous apparatus connected with the plant.

In conclusion, it might be well to add that all water and steam pipings, valves, safety valves, steam gages, thermometers, gas samplers, gas gages, etc., should be kept in first-class condition and always ready for use.

EDITORIALS

Attitude of Plant Owners and Engineers Toward Boiler Inspectors

A SURPRISING lack of appreciation is shown by some owners of power plants for the benefits to be derived from the services of the boiler inspector. Undoubtedly the larger number are by this time fully alive to the value of periodic inspection, but not infrequently the inspector finds some who are quite satisfied with the condition of their plants as far as they personally are aware. They have received the reports of their own engineers, and they regard independent inspection service as being entirely superfluous. Sometimes engineers share this view and express the opinion that they are quite as capable as the inspector to determine the safety and the condition of their plants; if they confess their own inability, they are ready to suggest other engineers whom they deem fully qualified.

Without disparaging the intelligence and ability of any engineer or power-plant operator, it must be obvious that the boiler inspector is the better fitted for work of the character outlined. In the first place, he is selected for his position because of special training and knowledge, and it is assumed that he applies these conscientiously to his work. He is constantly gaining new experience by meeting and studying the varied conditions of the plants that come under his supervision, and as a result he is better equipped for dealing with certain problems that may arise than is the man whose experience is limited to what he has learned while working in a small number of plants.

To attribute a little wider knowledge to the inspector does not cast any reflections on the ability of the engineer; therefore, there is no reason why he should feel humiliated when an inspector is asked to give an opinion as to the condition of his plant. It is altogether probable that if he had equal opportunities for building up his experience, he would prove as competent as the inspector, and possibly more so. Yet, when suggesting the benefits to be derived from inspection service, the answer oftentimes returned is: "Oh, we have a first-class engineer, whom we pay to look after our safety and interests, and no inspection is necessary. We rely entirely on him."

As a contrast, consider the engineer in charge of the machinery on a large merchantman or ocean-going liner. Before he can gain his certificate of competency as a first-class engineer he must serve a long apprenticeship in the engineering shop, and before attaining the chief's position he must serve many years at sea and then pass a strict examination. Yet he feels no humiliation when his engines and boilers are opened up for inspection by the proper authorities. On the contrary, he recognizes the necessity and wisdom of such inspection, because they help to form or confirm his judgment of the soundness of the machinery under his charge. Frequently they lead to beneficial changes that he might not be able to obtain unassisted.

The fact should not be overlooked that all data relative to the safe working conditions of plants regularly inspected are taken by the inspector, and are considered not by him alone, but are subject to the supervision of a competent engineering staff to which the reports are submitted. The steam user therefore profits by their additional experience and advice.

The necessity for periodic inspection is amply proved by the discovery of unsafe conditions, such as those mentioned in the article on page 389. But there are benefits to be derived from the pointing out of uneconomical practices. The wise owner or engineer long ago learned to look upon inspection as a check on both the safe and the economical working of the plant.

Electrical Reconstruction of France

ALTHOUGH it may seem somewhat premature to speculate regarding the reconstruction of the economic life of the invaded regions of France, it is a problem that will require solving in the near future, according to present indications, which are becoming more favorable each day as the German front is driven back. Undoubtedly, the use of electricity will be a gigantic aid in solving this problem because of its flexibility and its unlimited power of expansion for use in the reopening of factories, mines and other industries.

It is estimated that the power stations that existed in the region that has been occupied by the German forces would total about three hundred thousand kilowatts, and it is safe to assume that the majority of the power plants that were in operation before the invasion and those that were in the course of construction have been destroyed. One of the first problems to solve will be that of replacing practically the whole electric generating installations in the invaded region. This will require several years, as it will be impossible to complete the reconstruction of them all at the same time.

In order to facilitate the work, it would seem that the idea of standardization could be incorporated, a number of plants being designed with practically the same output, phase and cycles. This would greatly assist in the manufacture of the machines and would doubtless reduce the purchase price.

Doubtless temporary power stations will be built so that they may be placed into operation more quickly than if permanent stations were constructed. It is doubtful if the old transmission lines will be available, as they have probably been stripped of their copper wire by the enemy and either destroyed or carried away by them. It is likely that new transmission lines will be constructed according to the urgency of their installation.

Naturally, the size of the power station and the length of the transmission lines will be guided by the needs

of the regions they are to reach, but it would seem that the best plan would be to erect a number of central power plants capable of reaching to a considerable radius rather than a number of small ones. By this arrangement the future demands for coal would be reduced, and that is a matter that will receive serious consideration by the French government for some years after the ending of the war.

Save the Gasoline

THE first Sunday of September brought home to the general public the fact that there are other fuels besides coal and that there is a need to refrain from the careless and needless consumption of gasoline. The request by the Fuel Administrator that automobile owners east of the Mississippi suspend operation for pleasure on Sunday until further instructions, as issued, was generally observed. There were some who placed their own pleasure before the needs of the Allied governments and our own, but the number was small and their ride was not one of unadulterated pleasure.

There is more than one kind of slacker. It is easy to point the finger of scorn at the man who hesitates about getting into a service in which he stands a chance of losing his life, but a worse type is the man who will not put himself out or who refuses to forego a pleasure when by so doing the needs of certain branches of the army and navy and of our fighting forces may be met.

Fuel of one kind or another is necessary for the production of the greater portion of the power used in carrying on the war. For instance, enormous war demands in conjunction with the normal consumption of the railroads and other sources of consumption make it necessary to supply approximately seven hundred and thirty-five million tons of coal during the year ending next April, about one-fifth of which will be used for heating the homes of the people, and it is estimated that the production of bituminous coal will fall short about eighty million tons.

Some slight idea of what the consumption of bituminous coal for war purposes is can be obtained when it is known that a fifteen-thousand-ton troopship carrying our American soldiers to the fighting front burns about three thousand tons of coal per trip; or if an oil burner, about twelve thousand barrels of fuel oil. In fact, about four million tons of coal is burned each year in transporting across the ocean the supplies necessary to maintain our army.

The gasoline-fuel question is just as vital to the carrying on of the war as is that of coal, but of course to a lesser degree because less is used. For instance, there are thousands of patrol boats that are propelled by gasoline engines. These boats are in many cases heavily powered for speed and consume large quantities of gasoline. That they are necessary and are doing a great work is not to be questioned. Then there are the airplanes that are doing such valiant work in scouting, in bombing, and in observation work at the western battle front. Is a few days' joy riding by our people of more importance than these birds of the air? No one with a spark of patriotism will fail to lock the garage and keep it locked until the word is given that the gasoline supply is sufficient for our fighting units.

There is another branch of the service that is not brought to the attention of the people in the daily news—the munition train, made up of motor trucks loaded with cartridges, shells and other supplies. One can hardly conceive how the pleasure seeker can take out his car when he realizes that the five or ten gallons of gasoline he uses may be wanted by a motor truck loaded with ammunition that is sorely needed by our boys in the front trenches, who cannot make a successful resistance against an enemy attack unless there is a sufficient supply of ammunition with which to fight.

What about the wounded, of whom there are thousands? Would the pleasure seeker have them carried to a hospital on a dead-axle wagon, one without springs, or would an ambulance be better? Surely the latter, but ambulances are motor-driven and consume gasoline. If there is not a sufficient supply of fuel, they cannot bring in the wounded, who would be obliged to lie at the field hospital, where it is impossible to give them the proper attention. Result—suffering and death.

Is the Sunday joy ride worth the price? Does the pleasure gained offset the possible weakening of our fighting forces and the unnecessary loss of life and added suffering of the wounded? It does not, and be it said, that the great majority of our people will put the requirements of our country before their own pleasure. Those who will not should be made to do so.

A Chance To Win an Indicator

IN THE issue of *Power* for August sixth the Trill Indicator Company offers an indicator as a prize to him who demonstrates the most meritorious use of an indicator on a steam engine and another indicator for the best application of an indicator to a pump, compressor, gas engine, oil engine or apparatus other than a steam engine. A planimeter is offered as a second prize in each case. The president of the American Society of Mechanical Engineers, the Advisory Engineer of the United States Fuel Administration and the Chairman of the Committee on Power Tests of the American Society of Mechanical Engineers have consented to act as judges. It is a chance to win credit as well as the prize. Send in an account of your best accomplishment with the indicator before November first.

He Didn't Have To

A SALESMAN of power-plant apparatus, after demonstrating to the manager of a manufacturing establishment the saving that his appliance would effect in his plant, urged the desirability of getting the plant into the most efficient condition in view of the intended governmental inspection and rating.

"Nothing in it," was the manager's reply. "We are an essential industry. They have got to give us coal anyhow."

Speaking of impurities in coal, one of our subscribers, the chief engineer of one of country's largest chemical works, told us that he has three-hundred tons of coal, delivered last winter, in which there is only thirty-three per cent. combustible. And he knows where it came from and who was paid good money for it.

CORRESPONDENCE

Meeting an Emergency

One often finds men who do not put forth their best efforts when an emergency confronts them, for the reason that they have become discouraged because they believe that, not having had technical training, they cannot master things out of the ordinary; but I have become convinced that most difficulties are solved by resourcefulness and application rather than by technical knowledge. A few cases in point:

In a large three-wire 125-250 volt direct-current lighting plant it was found late one night that a lighting discharge had punctured the wiring conduit, fusing the neutral, one outside wire and the pipe all together. Current had to be on next morning at 5 o'clock, and inspection showed it would be impossible to clear the trouble within the limited time (the conduit was concealed in concrete) or to run new wiring to the distributing center.

Thus, although there remained two wires intact within the building, there was no current for the 125-volt lamps without throwing that load on one side and unbalancing the system beyond its capacity. The plant operator solved the problem by opening the neutral on the service side of the burnout, connecting jumpers at the distributing centers between the remaining outside wire and the circuits on the grounded outside, disconnecting the neutral from these circuits and installing 250-volt lamps. In a comparatively short time he had converted the lighting system into a 250-volt two-wire, until the necessary repairs could be made.

In a textile plant there were two direct-current generators running in parallel which, although of the same general characteristics, did not properly share the load, the indications being that at full load one machine robbed the other. The generator builders and an electrical engineer were consulted and, after checking over connections, offered various suggestions such as shifting the brushes, lubricating the commutator, increasing the size of the equalizer, substituting a smaller pulley, adjusting the shunts, but these changes gave no relief. The plant engineer then got busy and found that one ammeter started reading backward as soon as 75 per cent. of the scale indication was reached, so that as the load increased above this point, the instrument showed that the load was decreasing. A new ammeter cleared up the "mystery."

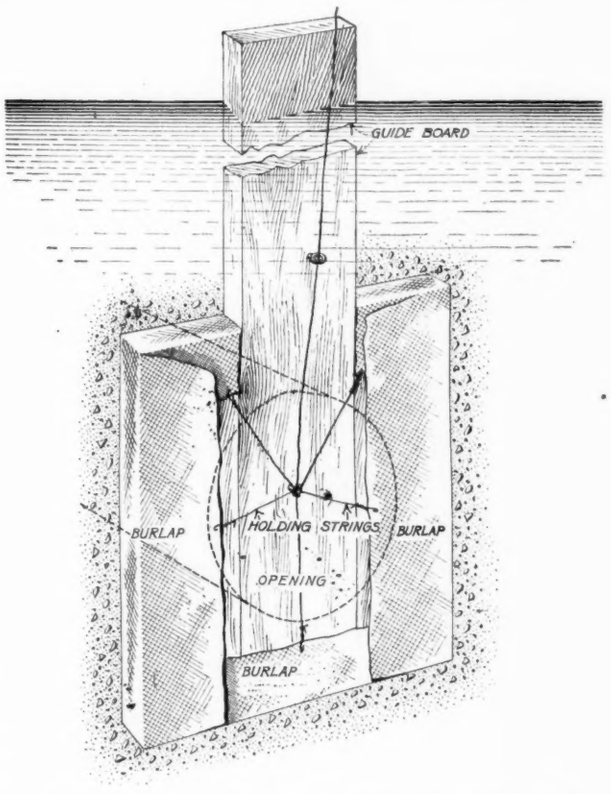
Shortly after the installation of a 150-hp. Corliss engine equipped with an automatic engine stop furnished by another manufacturer, it was found that at times the engine stop did not trip at a moderate increase of speed. The stop manufacturer put the matter up to the engine builder, and he in turn put the blame on the engine stop. Although frequent tests were made by each, no progress was made for more than a year, after which the operator decided to see what he could do independently of them. After watching carefully for some time he saw that the cause of the erratic action was the dropping of oil from the governor rod to the belt driving the stop. This had not been noticed before because the attendant had wiped it off frequently.

With the plant engineer I believe his success in clearing trouble is due rather to intuition and close application than to technical training. MATHEW KING.

Passaic, N. J.

Closing the End of an Inlet Pipe

It became necessary to make a connection to the 24-in. supply pipe from a reservoir at a point where the pipe was about 12 ft. below the level of the water in the reservoir. The pipe had no shutoff valve and attempts were made to close its inlet end with bags of sand without avail. A wooden "gate" was then tried



BOARD PLACED OVER THE END OF INLET PIPE

but considerable water leaked in between the wood and the irregular surface of the end of the pipe. Finally the job was made a success by placing a heavy canvas bag over the "gate" held snug by a string, as shown, before pushing it down in front of the pipe. When in position the string was broken and the bag released. The water pressure then forced the canvas into the leak holes and stopped them. JAMES M. PURCELL.

Richmond, Va.

Ground Caused Boilers Pitting

The boilers in this plant have been in constant use for over ten years, and until recently there had never been the slightest evidence of internal pitting or corrosion. They are practically free from scale, as we return the condensate from the heating system, cooking apparatus, etc., and the makeup water, about one-third of the total, is fairly good.

Suddenly, about a year ago, pitting occurred to an alarming extent and I was completely at sea as to the cause. At about the same time I noticed that the storage battery supplying current for the house-telephone system and electric bells was failing; that is, required much more frequent charging to maintain it at the proper strength. The battery seemed to be in fairly good condition, so I suspected grounds in the wiring. I finally located the trouble in an underground metal conduit running from the main building to the power plant, in which were three twisted telephone pairs. When we pulled the wires from the conduit, we found the insulation on all of them water-soaked and rotten and the conduit corroded through in many places. We put in a new conduit and new wires. This ended the battery trouble and also the pitting in the boilers.

Ash Fork, Ariz. W. G. CAMP.

Plastic Firebrick Boiler Baffles

In the Aug. 13 number of *Power*, page 243, R. McLaren suggests that a better way to construct the upper baffle for horizontal baffled boilers would be to stretch

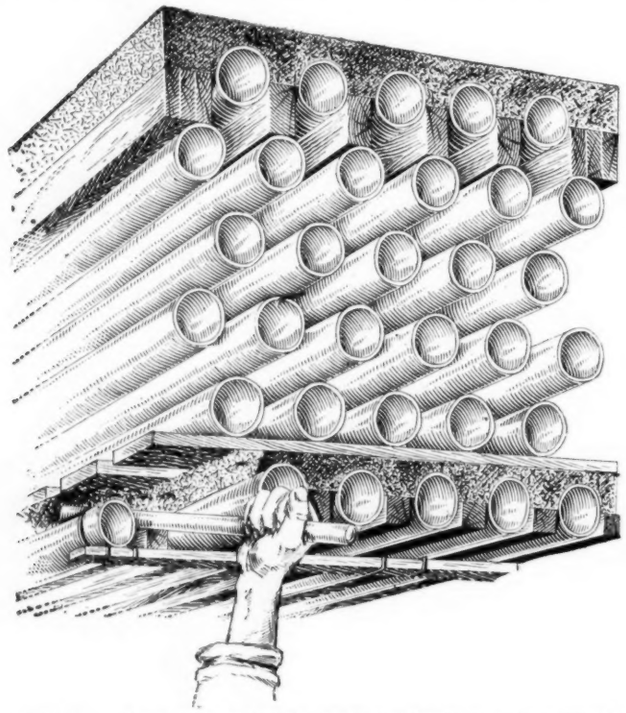


FIG. 1. BAFFLE CLEAR OF THE SECOND ROW OF TUBES

cheap cotton cloth across the tubes. Although we have never tried this way, it is our opinion that more time would be required to fix the cloth just right, keep it so and mold the baffle. The blocks of wood recommended are quickly put in place and are rigid enough to withstand hammering with a mallet. A piece of cloth, on the other hand, would be likely to sink down at the point where the refractory was being compacted with the mallet. This action would cause other points of the cloth to be pulled up and possibly disturb the material that had already been carefully placed.

It is common practice in horizontally baffled boilers of the Heine type to build the lower baffle in contact

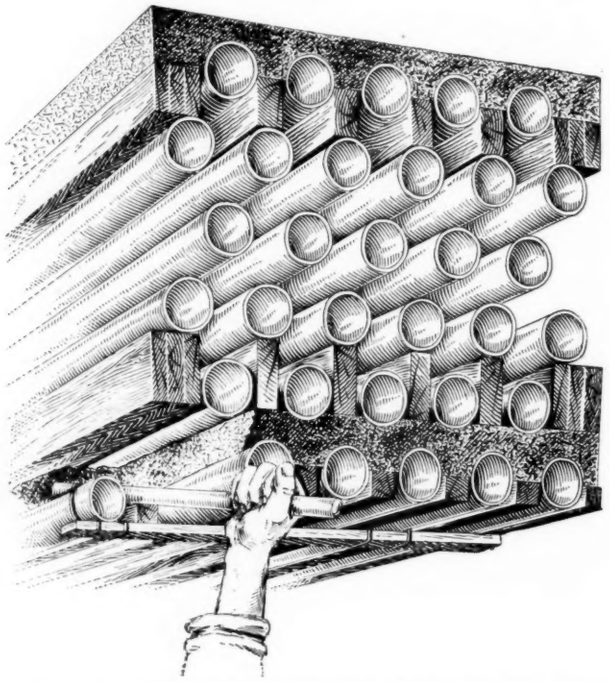


FIG. 2. A REPRODUCTION FROM PAGE 838 IN THE ISSUE OF JUNE 11, 1918—HOW MATERIAL IS PLACED FOR HORIZONTAL BAFFLES

with the second row of tubes. Where it is desired to have a lower longitudinal baffle, clear of the upper row of tubes; this may be accomplished by laying short lengths of half-inch boards flat, and crosswise of the furnace under the second row of tubes, instead of the lengthwise boards shown between the tubes. This method of forming the baffle is shown in Fig. 1. The reason why the lower baffle is often placed between tubes as shown in the illustration in the issue of June 11, page 838 (reproduced as Fig. 2), is that radiation from the fuel bed is thus utilized. Also, where boiler surface is not exposed to radiation from the fuel bed, a too high furnace temperature may result. With some fuels, however, this construction may be desirable. It has the same effect as a dutch oven, without the heat losses of the latter. This matter relating to baffles and furnace design has been nicely covered by Mr. Bromley in recent numbers of *Power*. Some designers consider it good practice to place the lower baffle between the second and third or third and fourth rows of tubes.

Rome, N. Y. NELSON ADAMS,
Betson Plastic Fire Brick Co.

Burning Fuel Oil

In the issue of July 16, page 997, Mr. Baker gives some very instructive matter on firing oil fuel, and I should like to add my views. The temperature of the oil is very important, as any increase in the oil

temperature, so long as the ultimate temperature is below the flash point, will aid in securing better conditions. I find 170 deg. F. at the burner suitable. The atomizing steam should remain at a constant pressure, therefore a reducing valve is usually placed in the atomizing line. The pressure may be anything from 80 to 125 lb. according to the boiler pressure carried. Superheated steam is better than saturated steam. In order to avoid explosions and backfiring while lighting a fire, the torch should be held momentarily at the front damper. If the flame be strongly drawn in, the fireman knows the back damper is open.

There are on the market several compositions which can be put on the boiler brickwork and effect great improvement in many cases, as they stop air leakages if properly applied.

In a plant where there is over 1500 hp. in boilers, an automatic oil-stoking system is to be desired, and if the load is at all variable, such a system is a prime necessity to economical operation, although there are few such systems. The one I have had most experience with, makes it possible, in fact easy, to maintain a high efficiency at all loads because the fuel oil, atomizing steam and air are controlled in a ratio that provides correct combustion. Each burner has a regulator and each regulator has three divisions, designated small, medium and maximum. The small fire is manually controlled and set to take care of the minimum load. The medium fire, once set, is automatically controlled. The maximum is also automatically controlled and is set to handle the maximum load of the plant. A master controller set governs all regulators and interlocking damper devices in the plant, providing for the interlocking of the damper movements with the apparatus controlling the flow of fuel and atomizing agent to the burners, insuring that the dampers are open correctly before additional fuel is admitted to the burners and that the flow of fuel to the burners is reduced before the dampers operate to reduce the amount of draft.

A constant CO_2 reading can be obtained at all loads in this plant and the temperature of the flue gases holds steady.

J. B. TAIT.

Anyox, B. C.

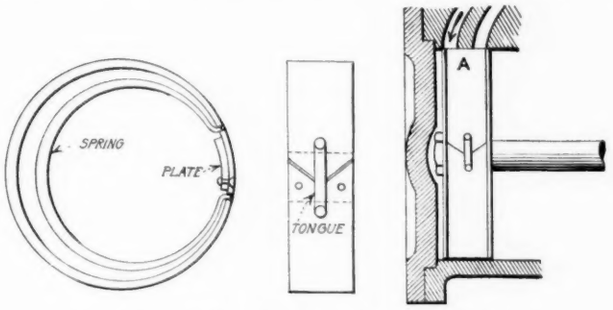
Pump Piston Groaned

The duplex steam pump is a simple and reliable machine, but on account of its peculiar valve gear, each side depending on the movement of the other, there sometimes occurs an aggravated case of trouble for the engineer.

At one time I had charge of a plant that required a boiler-feed pump for a 300-hp. boiler. A duplex pump made by a near-by manufacturer was installed. Everything went well except that the steam cylinders required an abnormal amount of oil. Repeated investigations proved that the cylinders and rings were in a smooth, polished condition and all parts nicely lubricated; yet the pump constantly groaned unless fed with an excess of oil.

The rings, as shown in the illustration, were wide, and but one in each piston. The joints were fitted with tongue across the gap between the ends of the rings, with a plate underneath, making a good steam-tight joint. The rings had sufficient spring to keep them against the cylinder walls, but an additional spring was put in to insure tightness. The makers advised removing the spring as the rings would have sufficient spring of themselves to insure tightness. This proved true, and the reduction in friction stopped the groaning as well as reduced the necessary amount of oil to reasonable quantity.

A new difficulty, however, presented itself which for a time threatened to elude its pursuer. One side had a tendency to stick on the head end of the stroke for



RING CONSTRUCTION AND PISTON

no apparent reason. The valves were properly set, the moving parts did not bind at this point and everything fitted so nicely that a leak seemed impossible. Yet it required 5, 10 or even 15 seconds for this side to make the first quarter inch of its stroke, after which it would move very nicely till it returned to this position. It was finally discovered that the piston so traveled over the steam and exhaust ports that when steam was admitted it compressed the ring *A*, allowing the steam to blow past. After the piston had traveled about ¼ in. past the port it then fitted to the cylinder wall. The remedy was to put in another piston with two narrow rings instead of one wide one.

But few makers use rings like the ones described, so I do not write this with the intention of assisting anyone out of a like difficulty, but rather to help make up the almost endless variety of experiences, related through *Power*, which makes better "trouble hunters" of us all.

B. E. ECKARD.

Wadsworth, Ohio.

Always Include the Heat

Although there have been many arguments for and against the central station, together with a recent splendid editorial, there is still something lacking as far as convincing one as to which side is right.

For instance, I am the chief engineer of a medium-sized manufacturing plant, but does the central station solicitor consult me when he proposes furnishing central-station power? Not he. He starts in with the men who know the least about the power end of production, gets them interested in his line of talk, and when they get to believe him I am called on to tell why central-station power should not be used. The powers that be seem set, and although they listen to my reasons for not using purchased power, they seem to think that as my position and salary are at stake I am prejudiced, therefore my arguments go for nothing.

There is a way, however, for engineers to bring the central-station man out in the open. Agree that his

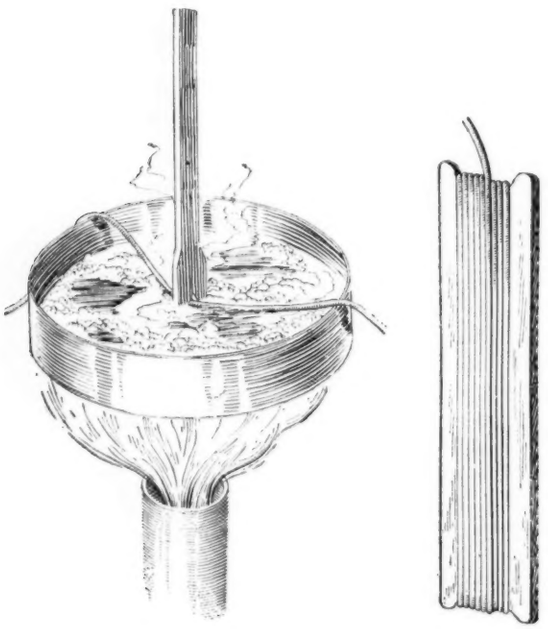
plant can and does make current cheaper than the isolated plant and then ask him if he will sell it cheaper than you are making it? It costs so many dollars for coal, so much for labor and so much for water, supplies and incidentals. Will he sell current and heat for the factory for less, and if so, how much less?

The present value of the steam plant will be a liability, for if it is not used, it will rust out faster than it will wear out when in use. Always ask the central-station salesman for the heat, because when the heating season is on the current is practically a byproduct in most cases. J. C. SCHENCK.

Brooklyn, N. Y.

Test Taper for Ammonia Leaks

I find the following method convenient for making a sulphur taper to use in testing for ammonia leaks. Melt a small quantity of sulphur in a shallow pan (I use the lid of a baking-powder box) and with a notched stick hold a wrapping cord down into the sulphur and draw it through. This will coat the cord with sulphur. The sulphur should be kept hot, otherwise it thickens,



COATING TWINE WITH SULPHUR

causing too much to adhere to the cord, making too much of a flame when it is used. Wind the tape on a piece of cardboard about six inches long (being careful not to break the sulphur coating), forming sticks of convenient length to hold while using.

To test for ammonia leaks, light a sulphur taper and hold the flame near the suspected place. Wherever there are leaks a dense white smoke will appear; even a leak that you cannot smell will cause a smoke.

Salem, Ohio. C. E. FREEMAN.

Power Used by Vacuum Pumps

Explanations of the power required by vacuum pumps frequently lead to wrong conclusions although the reasoning may be based on correct principles. With a perfect dry-vacuum pump with no friction, leakage or clearance losses and with perfect mechanically operated valves, when the pump is running but carrying no vacuum and discharging against atmospheric pressure it requires no power to operate since there is no difference in pressure due to the pump. When the same pump is operating against a perfect vacuum, there is nothing to compress in the cylinder and no power is required. Therefore, in the interval between the extremes the required power must rise from zero to a maximum and drop again to zero.

This curve is shown in an article by R. R. Pratt in *Power*, issue of Sept. 7, 1909, page 405. To see the reason for this curve it is only necessary to sketch ideal indicator diagrams of such an air cylinder for various degrees of vacuum. These will show that the maximum power is required at approximately 21 in. of vacuum. G. H. BRIDGES.

Holyoke, Mass.

Evaporation Tests Show Effect of Cleaning Boiler

Following is a report of two boiler tests "before and after" cleaning or "scaling," all other conditions remaining, as nearly as possible, the same. The object of these tests was to note the improvement after removing the scale.

Furnace hand-fired, grate surface 25 sq.ft., water-heating surface 1000 sq.ft., mine-run coal, duration of tests 6 hours each. Pounds scale removed 293.

	Test 1 Before Cleaning	Test 2 After Cleaning
TOTAL QUANTITIES		
Weight of coal as fired, lb.	4,320	3,903
Per cent. of moisture in coal	4.35	4.4
Total weight dry coal consumed, lb.	4,132	3,731
Total ash and refuse, lb.	610	459
Per cent. of ash and refuse in dry coal	14.7	12.3
Total weight water fed to boiler, lb.	27,423	26,466
Factor of evaporation	1.0712	1.0726
Total equivalent, lb., evaporation from and at 212 deg.	28,932	28,242
HOURLY QUANTITIES		
Pounds dry coal consumed per hour	688	621
Pounds dry coal consumed per hour per sq.ft. of grate surface	27.5	24.8
Pounds water fed per hour	4,570	4,411
Equivalent evaporation, lb. per hour per sq.ft. of water heating surface	4.82	4.70
AVERAGE PRESSURES, TEMPERATURES, ETC.		
Steam pressure by gage	102	99
Temperature of feed water entering boiler, deg.	184	182
Temperature of gases leaving boiler, deg.	568	509
Force of draft between damper and boiler, in.	0.45	0.51
Quality of steam, per cent.	99.5	99.5
CAPACITY		
Pounds evaporated per hour from and at 212 deg.	4,822	4,707
Boiler horsepower developed	139	136
Rated capacity, pounds, in evaporation from and at 212 deg. per hour	3,450	3,450
Rated boiler horsepower	100	100
Percentage of rated capacity developed	139	136
ECONOMY		
Pounds water fed per pound of coal fired	6.34	6.78
Pounds water evaporated per pound dry coal	6.53	7.05
Equivalent pounds water evaporated from and at 212 deg. per pound of dry coal	7.05	7.57
Equivalent evaporation from and at 212 deg. per pound combustible	8.21	8.63
EFFICIENCY		
Calorific value of one pound of dry coal	13,812 B.t.u.	13,246 B.t.u.
Calorific value of one pound of combustible	15,843 B.t.u.	14,875 B.t.u.
Per cent. efficiency of boiler furnace and grate	49.5	55.4
Per cent. efficiency of boiler and furnace	50.2	56.0
COST OF EVAPORATION		
Cost of coal per ton of 2000 pounds delivered in boiler room	$4.10	$4.10
Cost of coal required for evaporating 1000 pounds water from and at 212 deg.	$0.3054	$0.2829

Dyersburg, Tenn. S. R BLAKEMAN.

INQUIRIES OF GENERAL INTEREST

Right-Hand and Left-Hand Side of Pump—What determines the designation "right-hand" or "left-hand" side of a duplex pump? D. B. A.

According to the usual designations adopted by pump manufacturers, when the observer is standing at the steam end of a pump and facing the water end, the side on the left is the "left-hand side" and the side on the right is the "right-hand side."

Projection of Water Tubes Through Headers—In water tube boilers what distance should the tubes project through the tube sheets, drums or headers? E. R.

The ends of all tubes, suspension tubes and nipples of water-tube boilers should project through the tube sheets or headers not less than ¼ in., nor more than ½ in. before being flared and should be flared not less than ⅛ in. over the diameter of the tube hole.

Correcting Indicator Connection—The tapping for one of the indicator connections on the side of an engine cylinder is only partly into the counterbore and becomes nearly closed by the piston at the end of the stroke. How can this be remedied without boring and tapping for a new connection? F. E.

Free communication with the cylinder at all points of the stroke may be had, without injury to the cylinder, by chipping a channel from the tapped hole into the clearance, leaving no wire edges of the channel to cause abrasion of the piston rings and, of course, observing care that chips are removed so that the cylinder may not become cut or injury done to the indicator.

Duration of Boiler Tests—What length of time should be taken for conducting an evaporative test of a boiler? L. D.

The duration of tests of hand-fired boilers should be at least 10 hours of continuous running or such time as may be required to burn a total of 250 lb. of coal per square foot of grate. Where mechanical stokers are used, the test should be for at least 24 hours, though if the stoker is of a type from which the quantity of fuel and condition of the fuel bed can be accurately estimated, the duration may be reduced to 10 hours or such time as may be required to burn a total of 250 lb. of coal per square foot of grate. For commercial tests where the boiler to be tested must remain in continuous operation with frequent shifts of firemen, or when operated part of the day and fires are banked during the balance of the day, the duration of the tests should be at least 24 hours. Tests of maximum evaporative capacity should have a duration of at least three hours.

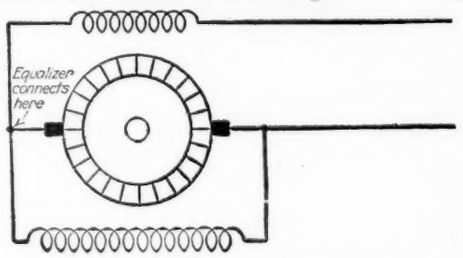
Settling of Outboard Bearing Foundation—Trouble is experienced in keeping the outboard bearing of a 16-in. x 36-in. engine in line on account of continual settling of the foundation which rests on an earth bed. What precautions can be taken against recurrence of the annoyance from a new pier foundation? E. W.

Probably the footing for the outboard pier was not built monolithic with the footing of the main foundation, or the foundation footings have parted. In providing a new foundation for the outboard pier, the excavation should provide for greater spread of footing and go at least as low as the bed of the main foundation and the footings should join and be anchored together as securely as possible. If good bottom is not reached by excavating to the depth of the main foundation bed, the new footing course should rest on a few spiles at the place where the reconstructed outboard pier is to be built.

Obtaining Samples of Flue Gases—Where should samples of boiler flue gases be obtained for analysis of the percentage of CO_2 resulting from combustion? W. L. T.

Samples of flue gases usually are taken from the breeching between the boiler and the stack. It is preferable to obtain the sample at a point where the gases are just leaving the boiler as a precaution against contamination of the sample by air leakages that would result in analyses showing lower percentage of CO_2 than should be credited to the combustion. The sample should be drawn into a piece of ¾- or ½-in. pipe long enough to extend nearly across the flue, with the sides of the pipe liberally perforated with ⅛-in. holes. When obtaining a sample of the flue gas, the sampling tube should be continually moved about in the uptake to obtain a gas sample fairly representative of the gases flowing in different parts of the cross-section of the uptake. For that purpose the tube should be provided with a tight-fitting flexible washer, made of thick rubber packing, placed on the tube outside of the breeching to form a gas-tight joint between the exterior of the tube and the side of the breeching at the place where the tube enters the breeching.

Equalizer Connection for Compound Generator—In compound-wound direct-current dynamos operating in parallel, does the equalizer of the various machines in parallel connect to each machine where the shunt field and the series field join; or is this connection at the brush of each machine that connects to the series field winding? V. K. S.



The correct point is that at which the series field is connected to the brushholder, as indicated in the sketch.

Utilizing Exhaust Steam of Ventilating Apparatus—Steam heat for a heating and ventilating apparatus of a school is obtained from the exhaust of an engine that is employed for driving the fan blowers. The condensate from the radiators is returned by underground pipe lines to a receiver from which it is pumped back to the boilers. There is a large waste of steam from the vent pipe on the receiver which is open to the atmosphere. How can this waste of heat be prevented? W. G.

With properly designed and operated heating apparatus an excessive discharge of steam from the vent pipe of the receiver would indicate that the heating system is supplied with more steam than it can utilize, and that the back-pressure relief valve is adjusted to cause higher back pressure on the engine than necessary for supplying the heating apparatus, thus wasting power. Any surplus exhaust steam should be employed, as far as available and required, for heating the makeup boiler-feed water in an exhaust-steam feed-water heater. The supply of exhaust steam required by the heating apparatus will vary with the state of the weather, and if the power developed by the engine is the same at all times, the amount of exhaust would be constant. If there is no surplus exhaust in the coldest weather, there will be an excess of exhaust steam at other times that has to be discharged as waste, unless it can be utilized outside of the heating and ventilating apparatus.

[Correspondents sending in inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications.—Editor.]

Smoke Prevention Association Holds Convention at Newark, N. J.

THE thirteenth annual convention of the Smoke Prevention Association was held at Newark, N. J., August 20-22, with headquarters at the Robert Treat Hotel, being the second such gathering in that city, the sixth annual convention having assembled there in June, 1911. About fifty delegates were present from all sections of the country as far west as Minneapolis, including municipal smoke inspectors, fuel supervisors and inspectors, and other representatives from cities and railroads interested in smoke-abatement work. The gathering, with different sessions held in the McCarter Gallery of the hotel, was one of the most successful which has yet convened, despite the reduced attendance brought about by the war. The program as arranged by Daniel J. Maloney, smoke inspector for the City of Newark and first vice president of the association, in conjunction with various out of town members, was thoroughly appreciated and enjoyed by those in attendance.

The opening session on Tuesday morning, following an informal reception to the delegates and guests, was devoted to preliminary work in connection with the convention. In the absence of President William H. Reid, Chicago, William A. Pittsford, Kewanee, Ill., acted as temporary chairman. Reference was made to the twelfth annual meeting held at Columbus, O., last September, Frank A. Chambers, secretary-treasurer of the association, reading a summary of the minutes of this convention.

Following, Mr. Maloney addressed a few words of welcome to those present, making reference to various features of the program as arranged for the convention. He emphasized the importance of reaching the fireman, the man with the shovel, in order to eliminate wasteful smoke. Mr. Pittsford, in closing the morning session, commented highly on the advance copy of a book brought before the meeting, compiled by Mr. Maloney for general distribution throughout the City of Newark in the interest of smoke regulation and coal conservation. This book, complete copies of which were later handed to the delegates, is a pamphlet of 78 pages, showing the various methods to be used for the installation and operation of furnaces to burn both soft and hard coal and outlining in a practical way features of automatic stokers, chimney construction and other boiler and power station equipment.

Tuesday Afternoon Business Session

At the first regular business session, Tuesday afternoon, Mayor Gillen, on behalf of the city, extended a warm word of welcome to those assembled. Referring to the work of the association, he said that while possibly foreign in a way to the general activities of members, he would appreciate the advice and counsel of those present in connection with the abatement of the fumes resulting from the operation of local acid plants, a problem now confronting the city; the matter was one of such vital moment that he wanted to bring it to the attention of the membership in the hope that some of the fuel experts might be able to suggest a remedy.

The initial address was made by Newell W. Roberts, vice president of the International Coal Products Corporation, on the subject of "Carbocoal," a smokeless fuel now being produced from high-volatile bituminous coal. He explained that carbocoal as developed has the essential properties of a perfect fuel, consisting primarily of fixed carbon and containing but 1½ to 4 per cent. of volatile matter. In combustion the fuel is smokeless, igniting with comparative ease and burning freely and completely under all ordinary draft conditions. The fuel, shaped by a briquet machine to insure a maximum density, is uniform in size and quality, dustless and clean. In structure it is hard and tough, permitting ordinary handling and transportation for long distances without disintegration. In color it has a resemblance to coke, being grayish black and with a density closely similar to anthracite coal. An analysis of carbocoal shows the following:

	From Mine Run, Per Cent.	From Washed Coal, Per Cent.
Moisture	1.00 to 3.00	1.00 to 3.00
Volatile matter	0.75 to 3.50	0.75 to 3.50
Fixed carbon	82.00 to 88.00	85.00 to 90.00
Ash	8.50 to 12.00	7.00 to 10.00
Sulphur	0.5 to 1.50	0.6 to 1.50

The company has been operating an experimental and producing plant at Newark, in the Irvington section, for the last three years, and with such successful results that the Government has been attracted by the possibilities of carbocoal, particularly for service on vessels going through the U-boat zone. Accordingly a new byproduct carbocoal plant has been established at Clinchfield, Va., near the well-known coal regions in that vicinity. This plant, representing an investment of $2,000,000, will be placed in operation early in 1919 and will be used primarily for the production of fuel for the Navy and merchant vessels.

Burning a Million Tons of Coal a Year

Frank W. Casler, general superintendent of production, Public Service Corporation of New Jersey, followed with a brief paper termed "Experience of Burning a Million Tons of Coal a Year, and How We Supervise It," as follows:

The supervising of the burning of a million tons of coal a year is indeed no small problem, especially in these times when we are obliged to take fuel that is unsuited to the furnace conditions of the various plants. Some of these stations are equipped with mechanical stokers of various types and designs, and others with the ordinary grate and hand firing.

The method of procuring a coal supply today has very materially changed from what it was in pre-war times; in other words, the pooling of coal gives us practically one grade for all plants and we are no longer able to select low-volatile coals that are so necessary in hand-fired plants in order to eliminate the smoke nuisance.

Previous to war times our contracts called for coal to be delivered to hand-fired plants where the smoke abatement was an important factor of not more than 17 or 18 per cent. volatile matter; but now the average volatile in the coal for all our plants ranges from 23 to 25 per cent., which adds materially to our difficulties in trying to cope with the smoke-prevention problem.

Our method of purchasing coal is a simple one; the contracts specify the average ash contained for any one month shall not exceed a certain percentage. Sufficient leeway is allowed for reasonable variation, and should it exceed this amount penalties are applied, but no premiums are paid if the average falls below what is specified in the contract, the object being to maintain as nearly as possible a uniform supply of fuel. Our method of arriving at the quality of coal is this:

A sample of about 1000 lb. of coal is taken from every 500 tons as it is received, from which small samples are prepared in the usual way of grinding, quartering, etc., and are properly marked and sent to the laboratory for anaylses. These analyses are averaged up at the end of each month, and if the ash content has not exceeded that specified, we consider that the standard quality of coal has been furnished.

Previous to war times a number of penalties were applied and considerable money was refunded. These refunds showing up in our power costs as they did prove our methods of purchasing coal were reasonably correct. All our principal plants, generating approximately 90 per cent. of our total power, are equipped with water meters, which periodically give us an evaporative test of each day's performance in the boiler room—this in addition to following up the quality of coal furnished. Thus we know how much water is evaporated per kilowatt-hour, affording us means for detecting furnace troubles.

Further, frequent tests are made of our engines and turbine units to see that the amount of steam generated is being used efficiently, and each engineer operating one of our plants has prompt knowledge of the quality of coal

he is getting and the over-all efficiency that should be obtained, and is in a position to detect waste very promptly, thereby insuring through any needed correction that our plants are always maintained at their maximum.

In an informal discussion, Mr. Casler said that the corporation was operating sixteen power stations tied in as one generating plant, and that under present-day conditions it was necessary to be on the job every moment to have smoke inspection as near 100 per cent. perfect as desired. He pointed out that the supervision of coal supply and quality, actively inaugurated about five years ago, had cut down fuel consumption about 100,000 tons the first year, and with favorable showings for the years following.

Speaking of the Essex power station, he explained that the thermal efficiency of this plant, estimated at 16.5 per cent. by the engineers at the time of completion, had averaged better than 18 per cent., or higher than any other generating station in the country, the next in line, as regards thermal efficiency, being the station of the Detroit Edison Co., averaging about 17.8 per cent. In conclusion he mentioned that while the coal situation was better at the present time than last year, the big problem confronting the company was that of labor, it being exceedingly difficult to instill 100 per cent. patriotism in the men and get the necessary work done. The labor conditions, he said, naturally would reduce materially the operating efficiency of the plants.

The next paper presented was by A. H. Blackburn, chief engineer of the Underfeed Stoker Company of America, entitled "Boiler Room Efficiency" and read in his absence by A. B. Curtis, Jr., of the same company. This paper will appear in an early issue of *Power*. The last paper of the afternoon session, "Smokeless Combustion with Chain Grate Stokers," by Thomas A. Marsh, chief engineer of the Green Engineering Co., was read by Secretary Chambers of the association in the absence of Mr. Marsh. This paper will also appear in an early issue of *Power*.

Motion-Picture Exhibit

A special motion-picture exhibit pertinent to the subject of smoke prevention was given at Proctor's Palace Theater Roof Garden on the evening of the first day of the convention, with admission by ticket. Mr. Maloney had extended invitations to operating men in and about Newark to be present at the exhibit, and about 100 persons were in attendance. Among the films shown was "The Troubles of a Building Owner," made by the Kewanee Boiler Co., and an industrial reel showing the value of electrification of railways, produced by the Westinghouse Electric & Manufacturing Co., termed "Romance of Rails and Power."

Wednesday Session

On Wednesday a morning business meeting was held to hear an illustrated lecture, "Bituminous Coal for Heating Boilers," presented by William A. Pittsford, Kewanee Boiler Co. This paper dealt with the subject of low-pressure heating boilers, explaining the difference between such types of boilers as compared with high-pressure units.

A short discussion followed until about noon, when the delegates and guests left for an automobile trip to the Newark watershed at Pequannock and vicinity. Deputy Commissioner of Parks and Public Property Frank J. Foley delivered an informal address to the delegates at one of the stopping places on the trip. An informal meeting of members and guests was held at the Robert Treat Hotel in the evening.

Thursday Was Railroad Day

Thursday, known as "Railroad Day," was given over to business sessions, both morning and afternoon. Thomas F. Lee, Woodhaven, L. I., gave a paper dealing with the smokeless combustion of fuels. His address covered personal experiences in combustion work, including experiments with different types of boilers at the Dover Boiler Works, Dover, N. J., and other industrial plants. He has invented a stoker upon which patent rights are soon to be issued, and, as an idea of the possibilities of this stoker, Mr. Lee made reference to an official test conducted by Jay M. Whitham, C. E., who stated that the economy obtained was high for an experimental plant, being a utilization of 74.1 per cent. of the calorific value of the coal, with economic evaporation of 10.52 lb. of water at and from 212 deg. F. per pound of dry coal containing 13,775 B.t.u.

An interesting address was given by H. D. Savage, vice president of the Locomotive Pulverized Fuel Co., showing the possibilities of the utilization of pulverized fuel on railroad lines. In this connection, he referred to results attained on the Atchison, Topeka & Santa Fe R.R., the Hudson & Delaware Co. and the Central Railway of Brazil.

As regards the use of pulverized fuel in stationary power plants, Mr. Savage pointed out the great possibilities for fuel economy and the employment of present commercial fuels which have not, heretofore, been considered of much economic value, such as Rhode Island graphite anthracite lignite coal of the South and Northwest, and the anthracite culm and slush, in Pennsylvania. These fuels, he stated, have been demonstrated to be thoroughly reliable when used in a pulverized form in the company's equipment, known as the "Lopulco Pulverized Fuel System." A series of tests made in June, 1918, with an Edge Moor boiler, using Illinois and Indiana screenings, showed an efficiency of boiler and furnace of 83.33 per cent. during a 12-hour period. The increase in efficiency over using the same grade and quality of fuel on grates or in retorts was 15 per cent., with a value of fuel saving during the period of run, at $5 per ton, of $10.80. The one difficulty manifest in the use of pulverized fuel is that it cannot be stored for lengthy periods without danger of spontaneous combustion.

The final paper of the morning session proved a highly interesting résumé of "Mechanical Stoking of Locomotives as Related to Smoke Prevention Problems," presented by W. S. Bartholomew of the Locomotive Stoker Co. He set forth that up to the present time 4500 mechanical stokers are in service on the railroads, distributed over several classes of locomotives from 50,000-lb. tractive effort type to about 100,000-lb., the largest number being on Mikados averaging about 55,000-lb. tractive effort. Only about 25 stokers have been installed on locomotives for switching service, and these primarily for the purpose of smoke prevention in the Chicago district on the Pennsylvania system.

The speaker referred to the action of the United States Railroad Administration in ordering mechanical stokers for application to all locomotives now in course of construction with a tractive effort of 50,000 lb. or over, and mechanical coal passers for smaller locomotives to be built. This shows, he said, the value placed on the mechanical stoker for efficient railroad operation.

Thursday Afternoon Session

The Thursday afternoon and closing session was opened at 2 p.m. by an informal talk by Robert Collett, New York, Conservation Department of the United States Fuel Administration. In bringing the railroad atmosphere into his address, the speaker said that one-third of the fuel consumption was by the different railroads and that with economy and right practice 16,000,000 tons might be saved annually. He urged coöperation on the part of the railroad men, with right supervision and economy to tend toward this enormous saving of fuel, explaining how by proper firing the consumption of coal by locomotives could be reduced materially, at the same time eliminating unnecessary smoking of engine stacks. He pointed out the importance of right quality of coal and the consideration of specifications for such delivery.

Reference was made to the present fuel conditions in New England. In this section there is 75 per cent. or less fuel stored for the railroads than at this time last year, while people in Boston have been instructed not to fire furnaces for heating until Dec. 1. He said the motto must be "Save a Shovel of Coal," and that the failure of an essential industry to obtain one ton of coal was equivalent to the loss of 100 working days.

C. D. Van Schaick, combustion expert, New York Central Lines, followed the speaker with a short talk on the subject "What Is Smoke?" The address was composed principally of anecdotes of his own experience as a smoke expert.

At the conclusion of the addresses, a formal business meeting was held for the election of officers for the ensuing year and the selection of the city for the next con-

vention. The Finance Committee presented a report showing a balance on hand of $818.92, as against $784.78 at the same period last year. The following were elected unanimously to office for the coming year:

President, Warren A. Edson, Boston; first vice president, W. H. Corbett, Michigan City, Ind.; second vice president, William A. Pittsford, Kewanee, Ill.; and secretary-treasurer, Frank A. Chambers, Chicago (reëlected). Chicago was named as the next convention city, with exact time to be fixed later, the secretary being instructed to call the gathering at such time as adequate accommodations should be available.

The convention had been scheduled to continue until Friday, the final day to be spent at one of the New Jersey coast resorts, but the desire of the majority of the delegates to return to their duties led to a curtailment in the initial plans. Following advices from William R. Reid, Chicago, president of the association during the past year, that he would be unable to attend, W. H. Corbett, second vice president, and now first vice president, presided at the different sessions after the opening day. A resolution was adopted to arrange for an exhibitors' hall at the next convention, to be available for the use of manufacturers of power-plant equipment for display purposes during the different meetings.

Government to Aid Power Plants

The proposed distribution of the $200,000,000 asked by the War Trade Board for Government construction or improvement of power plants in war industrial centers has been submitted to the House Commerce Committee by Lieut. W. W. Stanley of the army engineers. Following are the estimates:

New Jersey district, $5,500,000; Philadelphia district, $15,500,000; Pittsburgh district, including western Pennsylvania and eastern Ohio, $35,000,000; Baltimore district, including the territory between Lancaster, Penn., and Baltimore, $3,942,000; New England States, from the northern corner of Massachusetts to Providence, R. I., $14,625,000; Southern States, particularly in North Carolina, Florida and Alabama, $15,000,000; the Pacific slope, including some territory west of the Rocky Mountains, $10,000,000.

Most of this money is proposed for additional equipment for existing steam power plants.

Great Fuel Saving in Connecticut

The Administrative Engineer of the Bureau of Conservation, United States Fuel Administration in Connecticut, reports that those industrial plants that have furnished answers to the fuel-saving questionnaire are, in a majority of cases, making the changes suggested in the power-plant recommendations. Eighty plants, consuming for the year ending May 1, 1918, practically 337,000 tons of coal, as a result of the conservation changes suggested will save at least 15 per cent., or over 50,000 tons of coal, annually. This state had previously reported from similar sources an annual coal saving of approximately 31,000 tons.

The Administrative Engineers in Michigan, Kansas, Georgia, North and South Carolina and Florida have reported marked savings of coal in industrial plants as a result of the practical demonstrations of conservation.

Limit on Coal Storage

United States Fuel Administrator Garfield announces the basic policy of the Fuel Administration as to coal storage as follows:

Coal in excess of that required for current operations shall be delivered to plants not on the Preference List of the War Industries Board only when it is not in demand for use before April 1, 1919, by consumers on said list, namely, railroads, the Federal Government, states, counties, public utilities, retail dealers, or manufacturing plants on the Preference List.

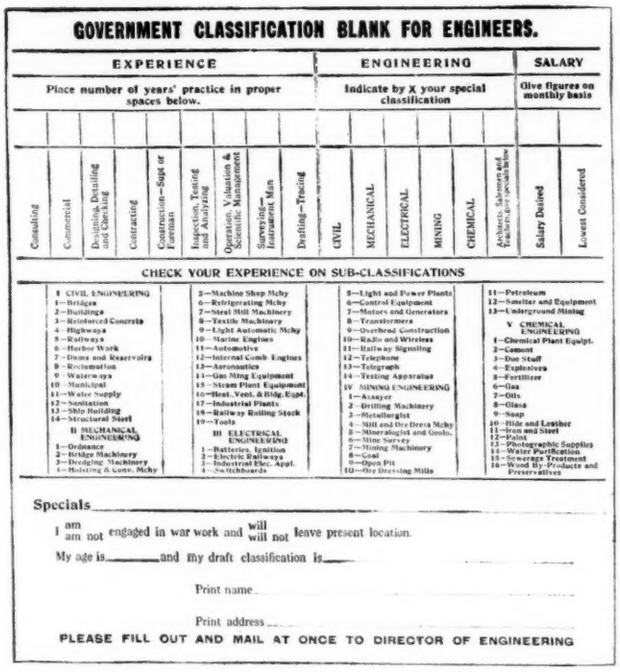
In carrying out this policy, allowance shall be made for differences in distance from the mines and for differences in transportation conditions which may require more or less storage at the beginning of winter to insure uninterrupted operation until the following spring.

MAXIMUM NUMBER DAYS STORAGE BITUMINOUS STEAM COAL ALLOWED UNTIL FURTHER NOTICE

	Public Utilities	Preferred Industries	Non-Preferred Industries
Maine	120	90	30
Mass., Vt., N. H., Northern N. Y.	90	60	30
Conn., R. I.	75	45	20
Southern N. Y., N. J., Del., Eastern Penn.	30	30	15
Md., D. C., Va., N. C., S. C., Ga., Fla., Western Ohio	30	30	15
Western Penn., W. Va., Eastern Ky., Eastern Ohio	30	20	15
Lower Michigan	90	45	20

Unusual Government Blank

Upon the recent establishment of the Division of Engineering, the Director of Engineering, A. H. Krom, declared that one of his first duties would be to effect a classification of engineers that would do away with confusion of terms, misconceptions and lack of definiteness in technical affairs. He is already making good his intention, judged by the registration blank that has just been published. Compared with blanks of the past, this particular one is a wonder. It is bound to be of great value to the engineering profession. A hasty glance will reveal



GOVERNMENT CLASSIFICATION BLANK FOR ENGINEERS.

EXPERIENCE — Place number of years' practice in proper spaces below.

Consulting | Commercial | Drafting, Detailing and Checking | Contracting | Construction—Supt. or Foreman | Inspection, Testing and Analyzing | Operation, Valuation & Scientific Management | Surveying—Instrument Man | Drafting—Tracing

ENGINEERING — Indicate by X your special classification

CIVIL | MECHANICAL | ELECTRICAL | MINING | CHEMICAL | Architects, Salesmen and Teachers, give specialties below

SALARY — Give figures on monthly basis

Salary Desired | Lowest Considered

CHECK YOUR EXPERIENCE ON SUB-CLASSIFICATIONS

I CIVIL ENGINEERING
1—Bridges
2—Buildings
3—Reinforced Concrete
4—Highways
5—Railways
6—Harbor Work
7—Dams and Reservoirs
8—Reclamation
9—Waterways
10—Municipal
11—Water Supply
12—Sanitation
13—Ship Building
14—Structural Steel

II MECHANICAL ENGINEERING
1—Ordnance
2—Bridge Machinery
3—Dredging Machinery
4—Hoisting & Conv. Mchy
5—Machine Shop Mchy
6—Refrigerating Mchy
7—Steel Mill Machinery
8—Textile Machinery
9—Light Automatic Mchy
10—Marine Engines
11—Automotive
12—Internal Comb Engines
13—Aeronautics
14—Gas Mfng Equipment
15—Steam Plant Equipment
16—Heat, Vent. & Bldg. Eqpt.
17—Industrial Plants
18—Railway Rolling Stock
19—Tools

III ELECTRICAL ENGINEERING
1—Batteries, Ignition
2—Electric Railways
3—Industrial Elec. Appl.
4—Switchboards
5—Light and Power Plants
6—Control Equipment
7—Motors and Generators
8—Transformers
9—Overhead Construction
10—Radio and Wireless
11—Railway Signaling
12—Telephone
13—Telegraph
14—Testing Apparatus

IV MINING ENGINEERING
1—Assayer
2—Drilling Machinery
3—Metallurgist
4—Mill and Ore Dress Mchy
5—Mineralogist and Geolo.
6—Mine Survey
7—Mining Machinery
8—Coal
9—Open Pit
10—Ore Dressing Mills
11—Petroleum
12—Smelter and Equipment
13—Underground Mining

V CHEMICAL ENGINEERING
1—Chemical Plant Equipt.
2—Cement
3—Dye Stuff
4—Explosives
5—Fertilizer
6—Gas
7—Oils
8—Glass
9—Soap
10—Hide and Leather
11—Iron and Steel
12—Paint
13—Photographic Supplies
14—Water Purification
15—Sewerage Treatment
16—Wood By-Products and Preservatives

Specials

I am / am not engaged in war work and will / will not leave present location.

My age is _____ and my draft classification is _____

Print name _____

Print address _____

PLEASE FILL OUT AND MAIL AT ONCE TO DIRECTOR OF ENGINEERING

its great advantages. It is compact and concise and uses the plainest terms possible. The individual technical man is given every consideration. He has a chance to place on the blank every detail of his experience and training.

The blank furnishes, also, an interesting sidelight on the engineering profession, as a whole. It shows how it has grown, how it has developed and how highly specialized are the various divisions and subjects. As a matter of fact, the whole history of engineering is embodied in the new governmental classification blank.

This is a good opportunity to urge every engineer to call at the local United States Employment Service office or write to the Director of Engineering, 29 S. LaSalle St. Chicago, Ill., for one of these blank classification forms.

The accident to the 12,000-kw. turbine-driven unit at the Reeves Avenue power house of the Virginia Railway and Power Co., Norfolk, appears, so far as we have been able to learn, confined entirely to the electrical end. The steam turbine does not seem to have been involved. We hope to be able to furnish more particular information later.

Dangerous Floor Openings

By CHESLA C. SHERLOCK

IT IS often necessary in industrial establishments to make openings through floors for the purpose of obtaining ready access to engine pits, basements, elevator shafts or to floors below. These openings, if properly guarded, are not dangerous to any person, but are a source of convenience and advantage to all. However, if they are unguarded, even temporarily, they become a fruitful source of danger and in many instances cause not only severe injury, but loss of life. The courts have many times been called upon to examine cases involving accidents of this nature and a number of the well-known rules of law, especially derived from the common-law practice, have found ample illustration.

In a late Pennsylvania case, it was found that the workman met his death while engaged in the duties of his employment by falling through a trap-door that covered an elevator shaft. It seemed that the trap-door was safe except when the elevator was in motion. It was customary to give warning of such fact by the use of electric bells that rang at intervals as the elevator was being used. The evidence disclosed that these bells were in a defective condition and that they oftentimes failed to ring; that at such times the operator of the elevator would ring them or cause them to ring by shaking the batteries and they would then ring for a while.

On the morning in question, the deceased was in a great hurry and he walked upon the trap-door, which gave way and caused him to fall down the shaft. There was no evidence to show that the bells had sounded a warning and there was no evidence to show that the deceased knew that the bells were not in working condition that morning.

The employer set up the defense of assumption of risk, but the court ruled it out at once, refusing to entertain it at all. The employer then attempted to prove that the deceased was guilty of contributory negligence in walking upon the trap-door without first ascertaining whether the elevator was in motion. This proposition the court held to be properly a question for the jury. The jury decided that the employee was not guilty of contributory negligence and the court affirmed the decision for the plaintiff.

In a Massachusetts case, however, the opposite decision was reached where it was shown that the deceased was employed in a factory where there was a trap-door. This door was used in storing goods in the basement and the evidence showed that there was sufficient light to make the door readily visible at all times. The deceased customarily worked alone on this floor, but at the time of the accident another workman came into the room and opened the trap-door, at the same time engaging in conversation with the deceased. During the course of this conversation, the deceased stepped backward and fell into the opening, receiving the injuries that later caused his death. The court was of the opinion that there was nothing in the case to show negligence on the part of the employer and accordingly rendered judgment in favor of the defending employer.

In a more recent Pennsylvania case it was shown that the plaintiff was compelled to use a dark passageway in the course of his duties. In this passageway, which was ordinarily lighted by electric lights, there was a trap-door leading to the basement. It was customary for all of the workmen in the plant to go down into the basement to eat their lunch and they were so engaged at the time the plaintiff entered the passageway. The plaintiff claimed that although he had worked for the defendant for years and had regularly used the passageway, he was not aware of the existence of the trap-door. Inasmuch as the lights had been turned off, the place was dark and he fell through the opening, sustaining the injuries for which he sought damages. The particular employee who had opened the trap-door claimed that he had placed a barrel there as a warning, but the evidence seemed to disclose the fact that there was no barrel there at the time of the injury. The court sustained a verdict in favor of the injured workman.

In a Massachusetts case the plaintiff was employed as a stationary engineer in the defendant's factory and was working on a night shift. In crossing the room to look at the governor on the engine, he fell into a pit, the door of which had been left open, and sustained the injuries for which action was brought. It seems that in the floor of the engine room were two pits into which the exhaust of the engine was drained, and these pits were covered with trap-doors that were opened from time to time to ascertain the height of the water in them.

There was evidence to show that on the day before the accident the plumbers had been working in the pit and the jury found, as a fact, that these plumbers were the ones who had left the door open. It was also shown that there was an electric light over the pit and that the room in which it was located was light. The plaintiff claimed that he had never seen the trap-door open before the accident, but he knew that it was necessary from time to time to open this trap-door. The lower court gave a verdict in favor of the injured workman, but upon appeal this verdict was set aside and judgment entered for the defendant.

In a Michigan case the deceased had been employed by the defendant for more than ten years. It was shown that there were two entrances to his place of work, either through the machine shop or through the power room. The deceased had been in the habit of riding a bicycle to and from work and instead of leaving it outside the building in the rack provided by the employer, he brought it into the building with him, and instead of leading it in, he was in the habit of riding it in through a narrow passageway between two large engine pits. This passageway was ordinarily protected by railings, but they had been removed in order to make some necessary repairs and had been down for several days. It was shown that the deceased attempted to ride his bicycle out of the place in the evening and that he struck an air hose lying on the floor, which caused his bicycle to skid, throwing him into the engine pit and killing him.

The evidence disclosed that the deceased had been warned from time to time that it was dangerous to ride his bicycle in that fashion, but that he had continued to do it, and had ridden over the air hose on several occasions. In view of these facts the court held that the defendent had failed in no duty which it owed the employee; that the place was well lighted; that the deceased was well acquainted with all the conditions of the place and that he had failed to heed the instructions the defendant had offered and that judgment should be entered for the defendant.

In an Iowa case, the plaintiff was employed in the defendant's machine shop and foundry. It was shown that there was an alley between the machine shop and the foundry and that in this alley there was a scale pit about 18 in. deep. The plaintiff was on night shift, going to work at 6 p.m., and the day before the injury workmen had been busy repairing the scale platform. They had been instructed to cover the opening with planks and place a warning light over the hole, but the evidence seemed to disclose that they had failed to do this.

When the plaintiff came to work, he registered on a time clock in the machine shop and then proceeded across the alley to the foundry. In opening the door to the foundry, he stepped back and fell into the scale pit, sustaining the injuries complained of. Three ribs were broken and in the case of one of the ribs adhesions formed which resulted in serious and permanent injuries. The court affirmed a judgment of $6000 in favor of the plaintiff.

These cases only point out the need of extreme care on the part of employers to protect properly all dangerous openings in floors and other places where workmen are liable to be injured. The mere fact that in some localities the workmen's compensation acts will change the measure of damages to compensation is no justification or excuse for permitting workmen to be injured in this manner.

West Penn Power Company To Erect $5,000,000 Plant

According to news reports an arrangement has been made by the United States Government with the West Penn Power Co. to erect a large electric power generating plant in the Allegheny Valley at a cost of $5,000,000 to partially relieve the serious power situation in the Pittsburgh industrial district.

The generating plant will probably be erected within a year on a site as yet undetermined near a coal mine of the company. Several sites are under consideration, including one in the Freeport district. Of the $5,000,000 necessary the Government has offered to supply $2,000,000.

It is understood that contracts have already been made for two turbo-generators of 20,000 kw. each. The plan provides for the erection of the necessary transmission system throughout the Connellsville coke region to make possible the furnishing of electric power in large quantities to industrial concerns which are now making or are about to make munitions and other vital war material. It is also understood that the transmission system will be so connected with the lines feeding plants in and about Pittsburgh that any surplus power available at any time may be distributed where it is needed.

Under the terms of the contract with the Government the West Penn Power Co. will finance $3,000,000 of the cost of the new generating station, the remainder of the estimated cost being furnished by the Government. Three years after the ending of the war the reduplication cost of the plant will be determined by a board of three disinterested appraisers, one to be chosen by the Secretary of War, one by the West Penn Power Co. and the third by the agreement of the first two. Whatever appraisements this board makes will be subject to the review and revision of the Secretary of War. The power company agrees to repay to the Government such part of the $2,000,000 advanced as the board of appraisers decides is the value of the plant in normal times above the $3,000,000 invested by the company. In other words, if the board of appraisers, three years after the war, decides that the plant can then be duplicated for $3,500,000 and the Secretary of War approves this appraisement, the West Penn Power Co. will repay the Government $500,000.

The assumption is that values of such buildings, electrical equipment and transmission material as may be necessary to complete the 40,000 kw. generating plant are now at least 66 per cent. above the normal cost in peace times, and the Government undertakes to assume this extra investment inasmuch as it is being made to assist in the more speedy production of war material. The West Penn Power Co. assumes the risk that in normal times it will be able to profitably use a large part of the increased generating capacity, sufficient at least to give it an adequate return on its investment of $3,000,000. So far as is known no provision is made for return to the company of any of its investment in case the appraised value of the plant three years after the war is less than the $3,000,000 invested, or in case the demand for power is not then sufficient to make profitable the continued operation of the plant.

Stop Oil Waste

The conservation of fuel oil, gasoline, kerosene, and lubricating oils is necessary, otherwise a shortage in their supply may result. It is suggested that every engineer carefully inspect his plant, and if any oil is found on the ground, floors, or engine beds, etc., to issue instructions to the operators to have the waste stopped. It is the drops that count!

A good recipe for polishing brass consists of 3 parts of oxalic acid dissolved in 40 parts of hot water to which is added 100 parts of powdered pumice stone, 2 parts of oil of turpentine, 12 parts of soft soap and 12 parts of fat oil. Another good one is rotten-stone 4 oz., oxalic acid in fine powder 1 oz., and sweet oil 1½ oz., with enough turpentine to make a paste.

The American loves aphorisms. He builds up public speeches out of a chain of them, or hangs them about his office. "Life is one d——d thing after another" is an example with which we are all familiar, and there are dozens more in daily use. In this the American is consistent. He is by nature a labor saver. He cuts off half his words and adopts rational spelling to save himself the trouble of writing or the expense of composing. If he economizes parts of words, it is but natural that he should aspire to economize whole words, and if words then sentences, and so thoughts. The aphorism is the shortest way of expressing a general truth. It conveys most with least labor, and if it is a good one it imparts just as much information as a chapter. It is a thought-tabloid. Here is one, picked out of a basketful, that Mr. Swaab prepared for the Engineers' Club of Philadelphia: "A man may be a great engineer with only sufficient scientific knowledge to eliminate the impossible." Mr. Swaab named several eminent men who exemplify this. We hesitate to follow him, because the law of libel in this country is as peculiar as it is strict, but we are confident that every reader of this can supply a dozen examples from his own experience. The ardent scientific reformer will deem it some derogation that a man may succeed in engineering with only just sufficient knowledge to keep him from falling into error, but half the difficulty in life is knowing what not to do. The remaining half is again divided into knowing what to do yourself and what to get others to do. We believe the successful semitechnical man knows all these things, and that is why he succeeds. He knows what cannot be done, he knows there are certain things he can do himself, and he knows, finally and most important, that there are certain things he must get others to do. Moreover, what he lacks in technical knowledge he makes up for in knowledge of men, which has been from the beginning, and will remain to the end of time, the best implement for opening the world-oyster. "A knowledge of men," Mr. Swaab writes, "is more to be desired than a knowledge of integral calculus, and by all odds it gives one a better chance in life." A fact, indeed. If you can know only one of the two, know men; but if you can know both, then by so much will you be the better than the possessor of one only.—*The Engineer* (*London*).

As the world has progressed, engineering projects of all sorts have increased in magnitude, in complexity and in diversity of human contracts. For their planning, execution and operation many men of many vocations must be called together, and many others indirectly must contribute from a distance. From the benefits of specialization, on which much emphasis has rightly been laid, our attention is being directed to the other necessity for greater breadth of education and sympathy, to intelligent, scientific coöperation, and to "beneficiency," which is efficiency as we have hitherto known it, plus humanity. Whipple, in his recent presidential address before the Boston Society of Civil Engineers, Sidney Webb, the Englishman, in his lectures and books, and many other writers and speakers are leading engineers and industrial managers into these fields so long neglected that to many they seem new and are teaching us the formulas for their cultivation. How slow we have been to learn! Those principles which we are now laboriously endeavoring to state were compactly enunciated many centuries ago. Unfortunately, they were early concealed by sanctimonious insincerity and surrounded with the mysticism of religion, falsely so-called, and have always antagonized selfishness. It is high time that engineers claimed these simple formulas for practical use as the basis of all genuine efficiency, stability, peace and civilization.—*A. D. Flynn, Secy. Engineering Council, at dinner of Boston Engineers.*

The Shipping Board is building 20 great ore carriers, such as Mr. Schwab had already built for the Cuban trade and which have been taken over by American interests. Several of these large steel ships recently sailed for Europe, each carrying 35 consolidated locomotives and 250 motor trucks.

Fuel Saving in the Home

The possible saving in coal used for residence heating may be divided into five principal items as follows:

1. Elimination of heating for unnecessary rooms and buildings: (a) Shutting heat off from rooms not actually needed; (b) closing of large residences where heating requirement is unreasonable for the number of occupants or the rearrangement of heating equipment in order to heat only the portion of house actually needed for occupancy.

2. Lower temperature maintained in homes: (a) A 5 deg. lower average than past practice would save about 10 per cent. of the fuel requirement.

3. Observance of practical methods of reducing preventable heat losses: (a) Insulation of cellar piping, heater or other sources of heat loss; (b) prevention of undue leakage at windows and doors.

4. Economical operation of heating apparatus: (a) The keeping of gas passages of heaters clean (by far the most vital factor and the most important to emphasize); (b) proper draft regulation; (c) sifting ashes where they contain fuel value; (d) the study and application of available war coal-saving rules.

5. The use where available of substitutes for coal as fuel—natural gas, kerosene oil, fuel oil, wood, peat.

An active educational program with punch and compulsion in it, as well as an appeal to patriotism, is required, and such program must necessarily be based on a plan of regulation and limitation of coal supply calculated upon quantities requiring economy. Only by such means can the average householder be aroused and impressed with the fact that if he does not study and apply the conservation rules, his negligence will react upon the comfort of his own family. He will run short of coal, while his neighbor who has observed the rules will have sufficient for his needs.

Information accumulated leads to the statement that a sufficiently consistent plan of apportioning coal for residence heating, cooking and hot water service by regulation and limitation, can be secured to make the enforcement practical. —*Frank T. Chapman at Worcester Meeting A. S. M. E.*

Personals

L. R. Bayer, formerly with the Bureau of Standards, has joined the organization of E. & T. Fairbanks & Co., scale manufacturers, St. Johnsbury, Vt.

F. E. McKee, formerly local manager of the Shaw-Crane Works at New York City has been elected vice president of Manning, Maxwell & Moore, Inc.

A. H. Charles Dalley, formerly manager of the Chicago office of the American Engineering Co., Philadelphia, Penn., is now consulting engineer with the Locomotive Superheater Co., Chicago.

Paul Bigelow, who has been representing the Buckeye Engine Co. of Salem, Ohio, in New York, since 1901, also for the last two or three years the Murray Iron Works, of Burlington, Iowa, has been commissioned as major in the Ordnance Department.

Engineering Affairs

The A.S.M.E. Local Sections of the Middle West will hold a big meeting at Indianapolis, Ind., Oct. 25-26. Cincinnati, St. Louis, Chicago, Milwaukee, Detroit, Birmingham and Indianapolis will be the chief sections represented officially, although the invitation to the meeting will be sent to every member of the society in the Middle Western territory, to members of local sections of other national societies and to members of local societies. It is expected that the Indiana Engineering Society and the Indiana-Lafayette Section of the American Institute of Electrical Engineers will join in with the arrangements. In the tentative program the hope is expressed that David Moffat Myers, advisory engineer of the United States Fuel Administration, will deliver the principal talk upon the fuel situation, supplemented with addresses from the state fuel engineers of the Middle West.

Miscellaneous News

The Kennedy Valve Manufacturing Co. has discontinued its office at Sioux City, Iowa.

The E. M. Dart Manufacturing Co., of Providence, R. I., announces that it is now located in its new factory at 134 Thurbers Ave.

The Boiler of a Threshing Engine Exploded on Aug. 19, on the farm of Neal Willis, near Peggs, Cherokee Co., Okla., killing three persons and seriously injuring three others.

A Boiler Exploded recently at the plant of the St. Charles Tile Brick Co., St. Charles, Penn., instantly killing one man and injuring the superintendent of the plant so severely that his recovery is not expected. The cause of the accident is given as low water.

The United States Steel Corp., acting for the Government, has awarded to the Westinghouse Electric Co. contracts for three 15,000-kw. generators for a generating plant which will cost approximately $5,000,000 to be used in connection with the Government ordnance plant now being built on Neville Island.

Power Curtailments in California—Gold-dredging companies in California have voluntarily surrendered to essential war industries 33⅓ per cent. of the electric power needed in their operations. Most of the dredging is being done in territories affected by the power shortage, chiefly on the American and Feather Rivers. An additional lessening of power for this industry may be necessary, according to H. G. Butler, Power Administrator of California, but meantime similar conservation measures in other industries are being planned to meet the emergency.

Trade Catalogs

Manganese Steel Wearing Parts for Tractors. Latest illustrated tractor bulletin issued by the American Manganese Steel Co., Chicago, Ill.

Zelnickers Bulletin No. 246. Walter A. Zelnicker Supply Co., St. Louis, Mo. Specifications and price list of tanks and accessories, piston rings, etc.

Rex Traveling Water Screens. Chain Belt Co., Milwaukee, Wis. Booklet 85; 20 pages, 6 x 9 in.; fully illustrating and describing the screens, showing some interesting installations.

Condensers, Pumps, Cooling Towers, Etc., is the name of Bulletin 112-A just published by the Wheeler Condenser and Engineering Co., Carteret, N. J. Persons contemplating the installation of a condenser will be interested in a discussion in this bulletin entitled "Choice of Kind of Condenser" and in the remainder of the bulletin, which illustrates and describes other Wheeler condensing machinery in detail. The bulletin embraces large and small surface condensers showing typical complete installations; rectangular and cylindrical types; jet condensers; barometric condensers; air pumps; rotative dry vacuum pumps; the turbo air pump; centrifugal pumps for circulating water; natural and forced draft cooling towers; the Wheeler feed water heater and multiple-effect evaporators and driers.

New Construction

Proposed Work

Mass., Brockton—The Walkover Shoe Co. has had plans prepared for the erection of a 3-story, 64 x 71 ft. concrete and brick power plant. Equipment including five 300 hp. boilers will be installed. Estimated cost, $56,000. Jenks & Ballou, 735 Grosvenor Bldg., Providence, R. I., Engr.

R. I., Newport—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., will soon award the contract for the installation of an electric distributing system here. Estimated cost, $75,000

Conn., Bridgeport—St. Stephen's Hungarian congregation society plans to install a heating system in the proposed new church to be erected on Spruce St. Total estimated cost, $125,000.

Conn., Norwalk—The General Trust Co., 48 Wall St., will install a steam heating system in the proposed 47 x 66 ft. bank building. Estimated cost, $65,000. G. F. Shepard, 14 Kilby St., Boston, Mass., Arch.

Conn., Oakville—The Autotyre Co. will install a steam heating system in the proposed 1-story, 40 x 150 ft. tire factory. Total estimated cost, $35,000. Guion Thompson, 27 West Main St., Waterbury, Engr.

Conn., Oakville—G. T. Thompson, Arch., West Main St., Waterbury, is receiving bids for the erection of a 1-story, 50 x 150 ft. wire plant for the Autowire Co. Equipment including electric motor will be installed in same. Estimated cost, $35,000.

Conn., Stamford—Yale and Towne Manufacturing Co., 548 Pacific St., will install a steam heating system in the proposed 6-story, 151 x 262 ft. factory. Total estimated cost, $440,000. J. A. Horne, Mgr.

N. Y., Buffalo—The Standard Oil Co., 26 B'way, New York City, has awarded the contract for the erection of a 1-story, 125 x 125 ft. garage on Elk St., to the H. D. Best Co., 52 Vanderbilt Ave., New York City. A steam heating and electric lighting system will be installed in same. Total estimated cost, $45,000.

N. Y., Geneva—City has awarded the contract for the construction of the heating plant to Johnston Heating Co., 131 East 26th St. New York City. Estimated cost, $4300. Noted Aug. 13.

N. Y., Ilion—The Remington Arms Co. is receiving bids for the erection of a 1-story addition to its plant on East Main St.; equipment including boilers and blowers will be installed in same. Estimated cost, $75,000. G. H. Dawson, Engr.

N. Y., Brooklyn—Brooklyn Navy Yard will receive bids for the installation of a heating system at the 24th St. pier.

N. J., Wharton—R. G. Cory, Engr., 39 Cortland St., New York City, is receiving bids for the erection of a 2-story, 50 x 126 ft. textile mill for the Wharton Textile Co.; equipment including motors, pumps and boiler will be installed in same. Total estimated cost, $30,000.

Penn., Philadelphia—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., plans to install a turbo generator in the Navy Yard, here.

Penn., Philadelphia—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., plans to install an air compressor at the Navy Yard, here.

Md., Indian Head—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., plans to install a turbo generator in the Navy Yard here.

D. C., Washington—The Construction Division, War Dept., has authorized the expenditure of $150,000 for each power house and laundry to be erected at the following camps: Camp Johnson; Camp Sevier, Greenville, S. C.; Camp McArthur, Waco, Tex.; Camp Las Casas; Camp Devens; Camp Gordon, Chamblee, Ga.; Camp Dodge, Des Moines, Ia.; Camp Grant, Rockford, Ill.; Camp Pike, Little Rock, Ark.; Camp Taylor, Louisville, Ky.; Camp Greene, Charlotte, N. C.; Camp Hancock, Augusta, Ga.; Camp Shelby, Hattiesburg, Miss.; Camp Sheridan, Montgomery, Ala.; Camp Beauregard, Alexandria, La.; Camp Wadsworth, Spartansburg, S. C.; Camp McClellan, Anniston, Ala.; Camp Meigs, Wash., D. C.; Camp Mills, Long Island; Fort Wright and Fort Terry.

Va., Hampton—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., plans to install a turbo generator in the Navy Yard here.

Va., Norfolk—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., plans to install a turbo generator in the Navy Yard here.

Kan., Buffalo—City plans election soon to vote on a $20,000 bond issue to rebuild its electric lighting plant. W. B. Rollins, 209 Railway Ex., Kansas City, Mo., Engr.

Kan., Kansas City—The Southwestern Milling Co., Dwight Bldg., has awarded the contract for the erection of a 6-story, 52 x 165 ft. addition to its flour mill on 18th and Kansas St., to Witherspoon, Englar Co., 53 West Jackson Blvd., Chicago. A steam heating and electric lighting system will be installed in same. Total estimated cost, $200,000.

Kan., Pittsburg—P. W. Enibo, Pittsburg Business College, will install a steam heating system in the proposed 3-story, 100 x 181 ft. business college on Broadway. Total estimated cost, $100,000.

Kan., Pittsburg—The Pittsburg Boiler Works has awarded the contract for the erection of a 1-story, 75 x 150 ft. machine shop on 2nd and Olive Sts. to A. Messenger. Equipment including motors, belts, etc., and steam heating system will be installed in same. Estimated cost, $12,000.

N. D., Grand Forks—The State University is having preliminary plans prepared by Rose and Harris, Engr., Auditorium Bldg., Minneapolis, Minn., for the erction of a power house. Estimated cost, $150,000.

Wash., Puget Sound—The Bureau of Yards and Docks, Wash., D. C., will receive bids until Sept. 16 for power plant improvements here. Estimated cost, $30,000.

Calif., Coalinga—C. T. Walker, City Clerk, will receive bids until Sept. 16, for engine, motor and pump for installation in the proposed auxiliary pumping plant. F. G. Dessery, Central Bldg., Los Angeles.

Calif., Los Angeles—The Board of Public Service Commission received authorization from the City Council to build the first unit of power plant No. 2 in the San Francisquito Canyon with revenue derived from sale of power. The project will ultimately cost about $1,400,000. E. F. Scattergood, Knickerbocker Bldg., ch. engr.

Calif., Mare Island—(Vallejo P. O.)—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., plans to install a turbo generator in the Navy Yard here.

Ont., Chippawa—Council plans to install an electric lighting plant here. Estimated cost, $6500.

Ont., Windsor—The Hydro Electric Commission plans to extend its hydro electric system. Bond issue of $75,000 was sold to finance the project.

B. C., Squamish—The Department of Railways, Ottawa, plans to build a hydro-electric plant here. Estimated cost, $250,000. W. T. Oliver, Victoria, Minister.

CONTRACTS AWARDED

Conn., Bridgeport—The Y. W. C. A., 263 Golden Hill St., has awarded the contract for the installation of a steam heating system in the proposed 3-story, 78 x 155 ft. dormitory on Barnum Ave. to R. H. Howe Constr. Co., 105 West 40th St., New York City. Total estimated cost, $80,000.

Conn., Torrington—The Fitzgerald Manufacturing Co., Railroad Ave., has awarded the contract for the installation of a steam heating system in the proposed 2-story, 50 x 300 ft. metal working factory to Westcott & Mapes, 207 Orange Ave., New Haven. Total estimated cost, $62,000.

N. Y., Bath—J. S. Maxwell, Pres. Board of Managers, New York State Soldiers and Sailors Home, received low bids repairing heating systems (a) all labor materials excepting Barracks D, E and F. (b) Barracks D, E, and F, from Hogg & Lynn Co., Inc., 165 Lake St., Elmira, (a) $19,486; (b) $12,779; Murtagh & Reddington, 26 Pleasant St., Rochester, (b) $13,500; F. T. Lawrence, 130 Pine St., Corning, (b) $22,933. Noted Aug. 6.

N. Y., Kings Park—The State Hospital Commission, Capitol, Albany, has awarded the contract for the installation of 7 underground heating service connections in Employees Home, to W. B. Armstrong Co., 3 Fulton St., Albany. About $12,988.

Penn., McKeesport—The McKeesport Tinplate Co. has awarded the contract for the installation of boilers in connection with the proposed 1-story, 80 x 150 ft. mill, to G. T. Ladd Co., Farmers Bank Bldg., Pittsburgh. Total estimated cost, $1,200,000. Noted May 28.

Penn., Philadelphia—Baugh & Sons Co., 25 South Calvert St., Baltimore, Md., has awarded the contract for rebuilding a boiler house, rock storage warehouse and railroad trestle on foot of Morris St. here, to C. L. Stockhausen Co., Gay and Water Sts. Total estimated cost, $250,000.

D. C., Wash.—The Bureau of Supplies and Accounts received bids furnishing 1 motor driven power press, Schedule No. 52864, Class 1004 from E. W. Bliss Co., Adams and Plymouth St., Brooklyn, N. Y.; $815; Manning, Maxwell and Moore, 119 West 46th St., New York City, $856; Sherritt Stoer and Co., Finance Bldg., Philadelphia, Penn., $860; Niagara Machine and Tool Works, 683 Northland St., Buffalo, N. Y., $898; Ferracute Machine Co., East Commerce St., Bridgeton, N. J., $1038.

Two generating sets, Schedule No. 53844, class 1006, delivery Brooklyn, N. Y., from Anderson Engine Co., 4036 North Rockwell St., Chicago, Ill., $1949; Friskie Motor Co., 56 College St., Middletown, Conn., $2945; Copely Manufacturing Co., 398 5th Ave., New York City, N. Y., $4300.

One 125 hp., 2200 volt, 1800 r.p.m., 60 cycle, 3 phase motor, Schedule No. 53954, class 1038, Fairbanks Morse and Co., 101 Light St., Baltimore, Md., $783; Lincoln Electric Co., Woodward Bldg., $793; Allis-Chalmers Manufacturing Co., Clinton St., Milwaukee, Wis., $820; Ideal Electric and Manufacturing Co., 153 East 5th St., Mansfield, Ohio, $850; Burke Electric Co., 12th and Cranberry Sts., Erie, Penn., $895; General Electric Co., River Rd., Schenectady, N. Y., $934; Westinghouse Electric and Manufacturing Co., Hibbs Bldg., $966.

Ohio, Akron—The Quaker Oats Co., Howard St., has awarded the contract for the construction of a 2-story, 47 x 50 ft. factory on Howard and Mill St., to the Leonard Constr. Co., 332 South Michigan Ave., Chicago. A steam heating system will be installed in same. Total estimated cost, $20,000.

Ohio, Akron—The Wellman, Seaver, Morgan Co., 7000 Central Ave. S. E., Cleveland, is receiving bids for the installation of a steam heating system in the proposed 3-story, 80 x 120 ft. factory, to be erected here. Total estimated cost, $80,000.

Ohio, Alliance—The Legal Order of Moose will soon award the contract for the construction of a 2-story, 50 x 70 ft. lodge and club building on South Main St. A steam heating system will be installed in same. Total estimated cost, $50,000. W. W. Matchett, Alliance Bank Bldg., Arch.

Ohio, Bucyrus—American Clay Machinery Co. will install a steam heating system in the proposed 1-story, 100 x 250 ft. factory. Total cost, $60,000.

Ohio, Bucyrus—The Board of Education, Scott Township, will install a steam heating system in the proposed 2-story, grade and high school. Total estimated cost, $50,000. Wm. Unger, P. O. Block, Arch.

Ohio, Cincinnati—The Board of Education has awarded the contract for the installation of the heating system, etc., in the proposed East Side High School, to the Sodeman Heating Co., 405 Gwynn Bldg. Estimated cost, $133,187.

Ohio, Cleveland—Detroit Ave. Methodist congregation, 1426 Winchester Ave., Lakewood, will install a steam heating system in the proposed 1 story, 75 x 90 ft. church on Detroit Ave. Total cost, $60,000. J. W. Christford, 1452 Highland Ave., Arch.

Ohio, Cleveland—The Hough Avenue congregation has awarded the contract for the construction of a 2-story, 58 x 70 ft. addition to its church, to the King Griffin Co., 841 Engineers Bldg. A steam heating system will be installed in same. Estimated cost, $50,000.

Ohio, Cleveland—The Lake Erie Smelting and Refining Co., 7900 Bessemer Bldg., has awarded the contract for the erection of a 2-story, 40 x 54 ft. factory at 7800 Bessemer St., to the Riley Constr. Co., 806 Leader News Bldg. A steam heating system will be installed in same. Estimated cost, $15,000.

Ohio, Cleveland—The Pennsylvania R R. has awarded the contract for the erection of a 1-story, 102 x 128 ft. engine house, at 1951 East 57th St., to Crowell-Lundoff-Little Co., 1951 East 57th St. Estimated cost, $20,000.

Ill., Chicago—The Crane Co., 80 East Jackson St., has awarded the contract for the erection of a 2-story, 80 x 380 ft. factory addition. The existing heating system will be extended. Total estimated cost, $425,000.

Mo., Kansas City—J. R. Samuels, City Purchasing Agent, received low bid for the erection of a steam turbine reduction gear centrifugal pumping unit, with 20,000,000 gal. daily capacity continuously against a total combined head of 370 ft. with 165 lb. steam pressure per sq.in. at throttle for Turkey Creek pumping station, from De Laval Steam Turbine Co., North Clinton St. and Pennsylvania R. R., Trenton, N. J. About $121,750. Noted Aug. 13.

Ont., Welland—The Dillon Alloys, Ltd., 122 Hellens Ave., has awarded the contract for the erection of a boiler house, and other additions, to Standard Steel Constr. Co., Port Robinson, Ont. Total estimated cost, $150,000.

THE COAL MARKET

Boston—Current quotations per gross ton f.o.b mines are as follows:

ANTHRACITE

	Circular Current
Buckwheat	$3.40
Rice	2.90
Boiler	2.65
Barley	2.40

All-rail rate to Boston is $2.86.

BITUMINOUS

Bituminous, $8 to $8.75.

Pocahontas and New River, f.o.b. Boston, $8.35 to $8.90.

New York—Current quotations per gross ton f.o.b. Tidewater at the lower ports* are as follows:

	Circular	Individual
Pea	$5.50	$6.25
Buckwheat	5.10	5.90
Rice	4.65	5.10
Barley	4.15	4.30
Boiler	4.60	....
Broken	6.75	7.50
Egg	6.65	7.40
Stove	6.90	7.65
Chestnut	7.00	7.75

Quotations for domestic coals at the upper ports are 5c. higher on account of the difference in freight rates. Prices for buckwheat, rice, barley and boiler are not fixed by the Government.

BITUMINOUS

Current quotations, gross tons, based on Government prices at the mines, net ton; f.o.b., Tidewater, at the lower ports, are as follows:

	Mine Gross	F.O.B. N.Y. Gross
Central Pennsylvania (Mine run, Prepared or Slack)	$3.30	$5.45
Upper Potomac, Cumberland & Piedmont Fields:		
Run of Mine	3.08	5.23
Prepared	3.36	5.51
Slack	2.80	4.95

Quotations at the upper ports are 5c. higher on account of the difference in freight rates.

The foregoing prices are exclusive of the 3 per cent. war freight tax on both anthracite and bituminous.

*The lower ports are: Elizabethport, Port Johnson, Port Reading, Perth Amboy and South Amboy. The upper ports are: Port Liberty, Hoboken, Weehawken, Edgewater or Cliffside and Guttenberg. St. George is in between and sometimes a special boat rate is made. Some bituminous is shipped from Port Liberty. The rate to the upper ports is 5c. higher than to the lower ports.

Philadelphia—Prices per gross ton f.o.b. cars at mines for line shipment and f.o.b. Port Richmond for tide shipment are as follows:

	Line		Tide	
	Current	One Yr. Ago	Current	One Yr Ago
Pea	$3.75	$5.00	$4.60	$4.00
Barley	2.40	1.90	3.30	2.15
Buckwheat	3.40	2.90	4.45	3.80
Rice	2.90	2.40	3.80	3.40
Boiler	2.70	2.20	3.70	3.30

Chicago—Steam coal prices f.o.b. mines:

	Illinois Coals	Southern Illinois	Northern Illinois
Prepared sizes		$2.55—2.70	$3.25—3.40
Mine-run		2.35—2.50	3.00—3.15
Screenings		2.05—2.20	2.75—2.90

Birmingham—Current prices per net ton f.o.b. mines are as follows:

	Mine-Run	Prepared Sizes	Slack or Screenings
Big Seam, Mary Lee, New Castle, Blue Creek, Brookdale, Milldale, Henry Ellen or Acmar	$2.45	$2.75	$2.40
Cahaba, Black Creek, Milldale, Carter and Durie seams, and Underwood seam in Etowah and Blount Counties, Jefferson seam in Marion, Walker and Winston Counties	3.45	3.75	3.10
Pratt, Brookwood, Nickel Plate, America, Jagger, Coal City, Jefferson (except in Walker, Marion and Winston Counties), Mt. Carmel seam or upper branch of Big Seam on Birmingham Mineral south of Bessemer	2.85	3.05	2.45
Helena and Harkness seams and coal mined by No. 2 Belle Helen, and Youngblood seam	2.90	3.20	2.70
Climax seam near Maylene, Shelby County	4.60	4.85	2.50